Tabletop games from table to tablet

Steffen Nygaard - 20113257

Abstract

This Study looks at the difference in learnability, memorability, and engagement between the digital and physical version of ‘Kingdom Builder’. Several areas of interest were found through a literature review. The different areas was investigated through two different investigations. The first had participants divided up in groups of maximum three. Each group either played the physical or digital version. In the sessions with the physical game the participants would learn the game through reading the manual, and in the physical sessions the participants would use the digital tutorial to learn the game. The investigation consisted of 28 participants that had never played ‘Kingdom Builder’. The investigation had a total of 11 sessions, six physical and five digital.
In the second investigation the participants would first first play the digital tutorial followed by playing the physical game. This was done because in the first investigation a factor used to measure memorability was not able to be performed in the digital game. This was only a pilot test and consisted of four participants divided into two sessions.
In the discussion, the study proposes that ‘Kingdom Builder’ include the digital version of the game in the box.
The study concludes that the digital version of the game has better learnability and memorability. The physical version of the game has better engagement.

Table of Content

1. Introduction

1.1. Define tabletop games

There is no official definition of the term tabletop games, even though it is commonly used within the industry and by the players. For the sake of this study the definition of a tabletop game is: A tabletop game is a collected definition of games played on either a tabletop or any flat surface. Tabletop games include many different kinds of games. The most well known would be board games where pieces need to be placed and moved from one place to another either on a fragmented or complete board. These are games like Chess and 'Settlers of Catan'. Another kind of tabletop game are card games. Examples of these could be Munchkin, Bridge or 'Five Hundred'. Other examples of different types of games within tabletop games are: role-playing games, dice games, and quiz games.

Most games utilizes elements from more than one kind of tabletop game. It is the main focus of the game that defines what type of tabletop game it is. This can be seen in a game like 'King of Tokyo' where the players play as big monsters, fighting to take control over Tokyo. Here the players roll dice to determine what actions their monster should perform. There is also a small board in the center of the table, showing what monster is taking control, at this time, and each player have a board showing the health and score of their monster. Here the dice is in the central game mechanic and therefore it is within the dice game type.

Illustration 1 - King of Tokyo

Through this paper the term tabletop game will be used even though the research only concerns a case study in the board game 'Kingdom Builder'. The reason behind this is that this case study can be reflected upon other tabletop games since, most tabletop games use the same formula of having a written ruleset that could as well be made as a digital gamified version.

1.2. History of tabletop games

To get a better understanding of tabletop games the following will introduce a compilation of the history of tabletop games. Different traditions of tabletop games will broaden the perspective of styles and types and give a better understanding of the evolution that tabletop games have had since its origin. The modern era of tabletop games have laid the foundation from which the future of the genre will grow. Much of the information have been gathered from 'The Oxford History of Board Games' written by David Sidney Parlett (1999), the book was published in 1999 and some things have changed since that time. This have been taken in consideration and have been supplemented in the following segments.

1.2.1. Ancient games

Proof of tabletop games have been found in egypt from as far back as the predynastic 3500 bc. (Peter a. Piccione, 1980). Tabletop games are still a big part of many peoples lives.

Illustration 2 - Collection of ancient games

The oldest, still played game (2500 years old), is the chinese 'go'. It is an area control game where players take turns placing stones on a 19 * 19 game board, hence competing to control the board(area). The game is a perfect information(deterministic) game meaning that nothing is hidden from the other player. 'go' have through the ages changed in many ways traveling throughout the world. This can be both in size of the board, that have been found in as small sizes as a 9 * 9, and in specifying the way of how areas are controlled. The first writings concerning 'go' are found in 'The Tso chuan' (Watson, 1991). From here it has evolved into the game still played today, mainly in eastern cultures. Many other games have been found at archaeological sites, but many of the rules are unknown as they have been lost through the ages.

Illustration 3 - go

1.2.2. Modern Tabletop games

There have been many changes to tabletop games since the days of Chess, Monopoly, Sorry(Ludo), and 'The Game of Life'. Many new game mechanics have been created and improved upon. Three major styles of tabletop games have emerged in western society through the ages. They are defined as American style, German/European style, and French style. Below, these styles will be described further.

1.2.2.1. American style tabletop games


Illustration 4 - Munchkin

American style tabletop games' foundation is based on competitive game mechanics in the sense, that players can choose to do actions directly sabotaging other players, making them lose progress, they already achieved. Games of this style are games like Munchkin. Munchkin is a game where each player plays the role of an adventure in a big dungeon. They compete against each other to be the first player to achieve level 10. Levels are gained by killing monsters or by receiving cards that will gain players a level. To defeat monsters the players will need 'Treasure Card', and 'Treasure Card' is only gained by killing monsters. The competitive part of the game concerns when a player fights a monster. Other players can either help the player in exchange for some of the 'Treasure Cards' which the monster will drop, after being defeated. They can also work against the player by increasing the strength of the monster, by using 'Treasure Card' gained from previous fights.

1.2.2.2. German/European style tabletop games


Illustration 5 - Agricola

German style or European style, depending on who you ask, are games that, opposite the American style, uses more co-operative mechanics where players play together, against the game as in games like Pandemic where players help each other to cure four major diseases, spread around the world. German style tabletop games can also be games that use its mechanics, to create a game where all players play the same game and sees who utilizes the games' mechanics better. The players are not aggressively trying to sabotage the other players' game as some players do in American style games like Munchkin, which mainly uses the backstab mechanic of destroying other players progress. These German style games are games like 'Kingdom Builder' or Agricola. In Agricola each player have a farm and farmers living in it. During each turn the player can use the farmers to do different actions for example, buying corn to sow in your fields. Each action can only be performed once in every round and only by one player in each round. This is the only way for the player to interact with other players by utilizing actions, such as buying corn from the market, to make sure that other players will not be able to buy any corn this round. Otherwise every player will play the game till the end and that is when scoring takes place. This is yet an important part of German style tabletop games that the score is mainly counted at the very end of the game instead of during the game. This reduces the risk of players feeling behind during the game and have every player engaged throughout the game.

1.2.2.3. French style tabletop games

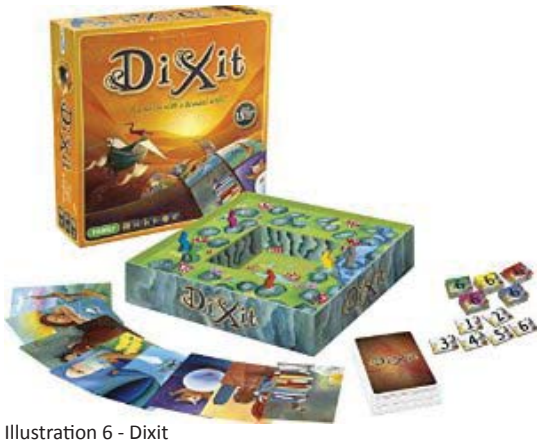

Illustration 6 - Dixit

French style tabletop games are the more creative games. These types of games are about communicating with the other players and working with abstract thinking. Games made in the French style are games like 'Trivial Pursuit', where players have to answer questions concerning different subjects and competing with the other players on who knows the most about the different subjects. The players have no way of interacting with each other concerning game mechanics. They play the game together for the social aspect, either for getting recognition with the other people or for having something to circulate their conversation around.

Another game in the French style is Dixit. Dixit is a game about abstract thinking. Every player receives a hand of cards with pictures. All of the pictures are in the surrealistic artstyle. For example the pictures could be, a ballerina dancing in a small cage, or a man sitting on the moon. The player in turn then chooses a card and places it picture side down on the table, and have to give a hint to what is on the picture. The hint can be anything: a word, a song, even a movement. Now every other player must find a card in their hand that they think fits the hint given by the acting player and place it picture side down, on top of the acting players card. When every player have put down one card on the pile, all the cards in the pile are shuffled and placed picture side up, on the table spread out so every player can see them. Now every player, except the acting player, pick the card they think the acting player played. Points are then given depending on the cards picked by the other players.

1.2.3. Move to digital

Since the introduction of the modern tablet from the 'Apple's IPad', more and more tabletop games are made with a digital counterpart. These games build on the same game mechanics, that is used in physical tabletop games. They are made with a greater focus on speed and connectivity. As an example, in 'Kingdom Builder', you are able to play with other people over the internet, thus creating the possibility of playing with other people from around the world. The score counting have also been made faster, so instead of each player carefully counting their total score, the tablet does it for you in a quick manner to shorten the game, and quickly start a new game.
Some games have taken another look at the tablet. Using it as a tool in the physical copy to do more complicated calculations, without needing the players to put in extra effort. 'Trivial Pursuit' have used this by having all the questions within the tablet but still use the board to move the physical pieces around. This also makes it possible for the publisher to correct or update questions online.

Illustration 7 - XCOM: the Board Game

A game called 'XCOM: the Board Game' are played as a physical tabletop game with a tablet as a tool. The tablet is placed next to the board when the game is in progress, this is done to increase the experience for the players. The tablet give the possibility to include more elements of surprise and randomness to the game. In the tabletop game you play a part of the management of the XCOM organization, from the video game of the same name. In each round the players have a limited time to perform all their actions, by time out, a random game element will happen. This game mechanic would be hard, if not impossible, to carry out in a regular analog tabletop game. During the combat phases of the game there are also a lot of attributes allocated to each unit and the combat would take a long time to carry out, using dice and looking up tables. Instead the tablet does it all for you and combat is reduced to looking at the tablet for a few seconds to see the result of the combat. It is a good blend between video games and tabletop games, taking the tabletop game to the next level, having computers do the complex calculations needed for the game. What the tablet also brings in, is the extinction of the physical game manual, in 'XCOM: the Board game', the tablet tells you how to set up the board, quickly goes through the rules of the game, and then help you through a few rounds before starting the real game.

2. Motivation

The original idea for this study comes from a love of tabletop games and learning to play new games. I also have a volunteer job as a board supporter at 'Aalborg Brætspilcafé'. Here my job is to know the rules of all the games in the cafe. Thus helping customers both finding a game and helping them to learn the rules of the game they want to play. From my experience of having to learn the rules for about 200 games in a matter of a few months, and teaching tabletop games to many other people, it occurred to me that there had to be a better way to learn the rules, other than having to read thousands of pages from manuals. I also have a passion for video games and thought that it must be possible to use the way video games teach the player how to play the game. I remember when I first started playing video games. I would have to sit and read the manual before knowing how to play. This have changed greatly since then, with the use of tutorials. The same teaching method should be able to be used with tabletop games. Some games are trying this way of learning but there have not been any research done on finding if there is any merit to using digital tutorials for tabletop games instead of a physical manual.

3. Problem statement

How is there a difference between the learnability, memorability, and engagement of the physical copy of ‘Kingdom Builder’ and its digital counterpart?

Is there any difference between the physical and digital tabletop game ‘Kingdom Builder’ concerning learnability and memorability?

What is more engaging to play, the physical or digital version of ‘Kingdom Builder’?

4. Kingdom Builder

Kingdom builder is an area control game created by the german publisher Queen games played by two to four players. It builds on the game 'go', as it is the original area control game where players take turn placing pieces on a board to control the best possible area. Instead of 'Kingdom Builder' being a deterministic game as 'go', where the player are able to determine all actions that can be made in the game, it instead changes it to a stochastic game, where players are not able to predict what will happen in the game.This is done by adding different terrains on the board and have players draw a card to show what terrain they can place on that turn. The game is of the european style of tabletop games, as players are not able to destroy progress other players have already made but only make it more difficult. Only at the end of the game, the score is tallied to make sure people do not feel left behind and is engaging for every player until the end. The game board consist of four different map sections that are placed in a square. To add replayability there are eight different map sections included in the box and in the setup phase of the game the four are chosen at random and placed in random positions. To further increase the replayability of the game, the way of scoring is also chosen at random every turn. This is done by the game having 10 cards called 'Kingdom Builder Cards'. These cards decree how the players will score at the end of the game. Only three of the 10 cards are picked in the start of the game and they are the same for every player. This means that in order for one person to play every different setup of this game, he/she would have to have played this game 464,486,400 times(this also includes same elements in different arrangement) if every game is different.

Illustration 8 - Gameboard setup of Kingdom Builder

In each turn a player plays his/hers 'Terrain Card'. The turn is then divided into a mandatory action and optional actions. The mandatory action and optional actions can be taken in any order. If the mandatory action have started no optional actions can be played until the mandatory action has ended. The mandatory action allows the player to place three Settlements (equivalent the stones from 'go') on the game board in the terrain defined on his/hers 'Terrain Card'. The optional action gives the player the opportunity to use a 'Location Tile' captured in a previous round. Any amount of optional actions can be made during a turn. 'Location Tiles' are captured by placing a Settlement next to the 'Location Hex' on the board and taking the location tile to his/hers personal supply. The most important rule of placing Settlements are that they must always, if possible, be placed next to already placed settlement. This also includes Settlements in Terrains located next to the Terrain described by the 'Terrain Card' or 'Location Tile' rules for the optional action. The game starts with each player have 40 Settlements in their supply and the final round starts, when a player have placed all of his/hers settlements on the game board. The last player to act in the final round is the player to the right of the first player, to place a settlement on the board.

At the end of each player's turn the player discards the ‘Terrain Card’, played in the beginning of his or her turn, and draws a new card. This is done to keep the pace of the game so that each player can plan their turn beforehand. It is important to keep this card hidden from other players as it can give them an advantage, if they know what terrain other players will place Settlements on, in their next turn. When the game ends the players, in coporation, count the score for each player starting with the first player then going clockwise. ‘Kingdom Builder Cards’ are counted one at a time for every player before starting counting for the next ‘Kingdom Builder Card’ to increase suspense.
To see a playthrough of the game including a short summary of the rules, ‘Geek and Sundry’ have a 35 minute video of the game (Geek & Sundry, 2015).

5. Literature review

In the following chapter a presentation of terms will be presented. These terms will elaborate and specify the problem statement (see 3. Problem statement). The key terms are as follows: learnability, memorability, and engagement. This will assist in the understanding and specify the scope of this study.

5.1. Learnability and memorability

In this study two different definitions of the term learnability have been found, each from different fields: computer learning and user research. In the field of computer learning, they define learnability as the learning algorithm classifying instances correct more often than random guessing (Schapire, 1990), (Blumer, Ehrenfeucht, Haussler, & Warmuth, 1989), (Crammer & Singer, 2002), (Linial, Mansour, & Nisan, 1993). In this paper however, the focus is not on computer learning but on the field of user research (Houser & DeLoach, 1996, 1998), (Natoli, 2014), (Gobet, Retschitzki, & Voogt, 2004). In the following a clear definition of learnability and memorability will be examined for this study. Memorability can be seen as a part of the term learnability, but is used to give a clearer distinction between, when there is talk about the learning phase (reading the manual or playing the tutorial) and the gameplay phase (playing the game).

Rob Houser and Scott DeLoach, in the papers “Instructional design lessons technical communicators can learn from games” (1996) and “Learning from games: Seven principles of effective design” (1998), defines learnability as the product's ability to help the user, in the transition from a novice to an expert level user. You can argue that Houser and DeLoach’s definition of product, can be a software but also for example a tabletop game. The different elements that products can learn, from the way video games increase learnability includes: The way of clearly stating goals for the user, having a transparency of the different controls and functionality, and only show the player what controls are available at that specific point in the game. The way of demonstrating what can be accomplished within video games are either through:

1. Video.
2. Plain graphics.
3. Placement in the game environment.
4. Giving the player the right amount of motivation from showing the player’s performance through different information means at the correct timing.
5. Brief instructions given to the player in small steps without giving the player too much information at a time or before the need for it.
6. The use of artificial help to let the player succeed in the beginning and give enough experience to ensure motivation.
7. Providing consistent feedback either through:
    1. Score system.
    2. Visual cues.
    3. Audio clips.

‘Kingdom Builder’ in the digital version uses all of the methods described by Houser and DeLoach in their papers(1996, 1998), whereas the physical game lack many of the methods. This is for instance shown in the case of audio cues, that are near impossible to have in a physical game. But things like having the manual include predefined game scenarios, could help improve players learnability of the game. To summarize what Houser and DeLoach (1996, 1998) tries to accomplish, is to show how many products, other than video games, can benefit from utilizing the same methods, used to increase learnability in video games.

Joe Natoli (2014) is a user experience consultant with more than 28 years of professional design work. In his blog he talks about how to create a great user interface. His work is gray literature since Joe Natoli is not a scientist or have published any papers. He has co-published one book on the service oriented architecture and published a book concerning user experience. Even so, Natoli works with terms which shows a way to measure learnability in a product.

Natoli (2014) define learnability as having a symbiotic relationship with the comprehensibility of a product, as if the user is not able to understand the product, they will never be able to learn it or vice versa. He also defines it as, the lower the cognitive load the product needs, the higher learnability it has. He describes a product with high learnability to have been highly intuitive. He defines intuitive as a single trial learning, meaning that it has to be easy to see the order of which actions needs to be taken, to perform a specific action.
Natoli (2014) describes four different factors that can be used to measure the learnability of a product:

1. **Effectiveness**: How much of the product users are able to learn successfully.
2. **Efficiency**: The time it takes for a user to learn to use the product and their efficiency in using the product.
3. **Satisfaction**: How much a user feels satisfied by looking at the amount of time, effort, and cost, for learning the products functionality.
4. **Errors**: The number of errors the user makes, also if they are able to correct them and how long it takes for them to correct the errors.

Natoli operates primarily with the term learnability, but you can argue that he includes memorability within the term learnability. In this regard, the user's ability to remember what they have learned. Due to his use of a combined definition of learnability and memorability, some of his four factors, for measuring learnability, needs to be split to fit the definitions of learnability and memorability used in this study, as seen in the last half of his term efficiency ("and their efficiency in using the product"), and in his term of errors.
The last part of efficiency would fit better in the definition of memorability, as that it is contained in the usage of the product and not the learning process of it. How efficient a user is able to use a product are depending on how easily they can memorise the different steps, needed to perform an action. The errors, a user performs during the use of a product, after they have learned the product, fall under the definition of memorability. The reasoning behind this is that the error happens because of the user is forgetting, what they had learned.
All four factors previously mentioned will be used during the investigation of 'Kingdom Builder', to measure the learnability and memorability of the game.

In the book, ‘Moves in Mind: The Psychology of Board Games’, Fernand Gobet, Jean Retschitzki, and Alex de Voogt (2004) look through research made on how people evolve in skill level as time passes, and more games have been played. For this study their terms of different ways of learning, will be a guide for how manual and tutorial based learning differ.

In their studies they found how people learned to play games and how there is a difference between participants, that were expert chess players, and psychology students with little tabletop game experience. All of them had no experience with the game Awele, which is a very popular game in Africa with rules similar to Kalaha. Here each participant was given 10 hours to learn the game. Three different ways were used to teach the participants the rules:

1. **Self taught**: Here participants would get a written page of the rules and the game and given 10 hours to read and practice.
2. **Expert observation**: The participant would observe an expert player play the game for five hours and after that they would have five hours to practice.
3. **School taught**: Participants would get a five hour demonstration and lecture of the key concepts of the game and then five hours of practice time.

The study showed that the chess players had a faster understanding of the rules and their learning curve was much steeper. This shows the importance of how prior experience, within similar products, can have, for a user’s ability to learn a product other than the learnability of the product.The study found that the most effective way of learning the rules, was the expert observation and School taught way. Gobet et. al. (2004) in the abovementioned terms gives a broader perspective of learnability. The terms show different ways to include learnability in a product. As seen in the digital version of ‘Kingdom Builder’ that use the school taught learning method. In its tutorial, players are given a box of text which is talking about a specific part of the rules. When the players know the basics, the game first shows how it works and then have the player replicate it. An example is when the player is taught how to place settlements, the tablet places three settlements on the board, then tells the player to place three settlements on the board specifying where to place them. Where the physical version of ‘Kingdom Builder’ uses the self taught method, through the use of the included manual. Therefore being different from each other in the way of learnability.

In this study the definition of learnability and memorability are:

- **Learnability**: A product’s ability to assist in the users transition from novice to expert.
- **Memorability**: The user's ability to remember the functionality of a product and its order of operations.

Further down (see 5.4. Found areas of interest) a summation of how the different studies will be used, to investigate the difference in learnability and memorability in the game ‘Kingdom Builder’, will be elaborated.

5.2. Engagement

The theories chosen to support the term engagement are not presenting an explicit description of what engagement is. Although, they mostly have a more practical approach, the theories will clarify some aspects of how engagement is important. Furthermore these studies will prepare the grounds for a discussion of the merits of the digitalization of tabletop games. In the following, studies by Mihaly Csikszentmihalyi (1997), Marc Prensky (2001a, 2001b, 2003), Henry Jenkins(2002), and Erik Andersen, Eleanor O'Rourke, Yun-En Liu, et. al. (2012), will be presented and reflected upon.

Csikszentmihalyi (1997) try to define engagement through his term flow. Flow is the combination of skill and challenge. He defines a person as being in flow(engaged) when the challange is equal to the person's skill. In Csikszentmihalyi's definition of flow(engaged) he define that if a person's skill is higher than the challenge he/she will enter a zone of boredom. If instead the challenge is greater than the person's skill the person will enter a zone of anxiety.
Csikszentmihalyi have been included in this study to help create a clear definition of engagement to use in the later investigations.

Prensky (2001a, 2001b, 2003) are one of the strongest spokesmen for using digital game-based learning. He sees that there is a big difference between how the new generation (Games Generation) and the older generations will be able to use digital game-based learning. The 'Games Generation' have grown up playing computer games, watching television, and using many other digital media, therefore they are already familiar with the functions of the previously mentioned media.
Prensky (2001a, b) talks about three main reasons why digital game-based learning will at some point become an accepted way of learning:

1. Computers are able to simulate and help the user learn, in many different ways.
2. It is motivating and fun.
3. The ability to apply any subject to a digital experience and adapt to the skill level of the user.

The problem with Prensky's studies are that he assumes, that people of the 'Games Generation' will always be engaged and motivated, to learn by playing digital games. As this is a generalization and might not be true with everyone in the 'Games Generation'(the main audience of tabletop games). Prensky's generalization encourages a discussion of digital games and how they supposedly are always more engaging, than their physical counterpart. Moreover his third reasoning will not be used for this study, but shows how Prensky sees digital game-based learning as the optimal way of learning.

Jenkins (2002) finds that the educational value of games include the ability to nudge people to the next level. Educational software and games have the ability to adjust the difficulty to fit with the player's own ability, compared to traditional teaching methods that are made to fit a specific group. Games also have the ability to enable different learning styles at the same time. The biggest problem Jenkins finds with educational software given it be games, or other software, is the low quality of the products. Many games or tutorials have in some ways a very low quality with bad graphics and even worse story elements. This is mainly due to the low production cost that is put into these products. This is also the case for the digital version of 'Kingdom Builder', compared to the quality of the physical version. It looks like not a lot of resources was put into the tutorial, as there were times where the tutorial would just display a wall of text for the participant to read. This was done instead of showing it with a series of pictures or by showing it on the digital game board. Some features that participants found essential to the game was missing, as the ability to go back one move if a misclick had occurred. This is a common theme in touch based games that participants would not click where intended. Jenkins have been included due to his view of the importance of the quality of a product, and how this affects the user's engagement. This also relates to Natoli's (2014) term of satisfaction being a part of the learnability of a product.

Andersen et al. (2012) looks at three self made digital video games of varying complexity. Eight different tutorial designs were made to investigate the impact tutorials had, on games depending on their complexity.
They found that the complexity and amount of game mechanics, that can be learnt by exploring rather than taught by a tutorial, can have a difference in how the game should be learned. It was only in their most complex game that there was a significant difference in learning, but it did not increase the level of engagement the participants had with their game. In the less complicated games the more extensive tutorials would increase the time of play greatly and reduce the engagement of the player with the games, as they would think it would be faster to explore the mechanics by themselves.
This could be the same with digital tabletop games. If looking at a solitaire as FreeCell, players might find it easier to explore how the system works instead of playing through a long and complex tutorial. Where games like 'Kingdom Builder' have higher complexity, and might need a tutorial for players to understand the different systems.
This is also further confirmed when looking at Natoli (2014). He discuss how there is a direct connection between learnability and the cognitive load required by the user. If the game is simple enough for users to learn through exploration, including more complexity to the tutorial would just increase the cognitive load needed, as the user will have to think more about the tutorial than playing the game.

In this study the definition of engagement is:

- **Engagement**: A person's motivation to continue using a product.

Further down (see 5.4. Found areas of interest) a summation of how the different studies will be used to investigate the difference in engagement, in the physical tabletop game 'Kingdom Builder' and its' digital counterpart, will be elaborated.

To connect both learnability, memorability, and engagement, Thiagarajan(1993) will be presented. He talks about how using all three elements can improve the user's experience, learning games through a tutorial.

Thiagarajan (1993) argues that experts, within a subject, have a greater ability to concentrate on what is important, for what they are doing, and will not be distracted by the irrelevant details presented to them. He states that there are three levels of mastery: acquisition, application and automation. This can also be described as the transition from novice to expert. The table below shows how Beasley (2004) summarises how Thiagarajan (1993) describes how game tutorials can be designed to compensate for each of the different levels of mastery.

	Acquisition	**Improving fluency of transfer**
Presentation	Walkthrough of the game followed by immediate replay in a similar context.	Rapid drill and practice. Leave the learners to their own devices.
Complexity	Reduce the number of variables.	Increase the number of variables, both relevant and irrelevant.
Fidelity	Simplify reality.	Reflect reality as closely as possible.
Timing	Slow and deliberate, no time pressure.	Real-world time constraints or faster.
Guidance	Hints, clues and prompts.	Provide only those reference materials available in the real world.
Motivators	External motivators.	Avoid external motivators.
Divergence	Minimise variation between one problem situation and the next.	Make problems divergent from one another.
Sequencing	Keep the transition between different rounds gradual.	Present problem situations in random order.
Decision making	Walk through decision-making activities.	Real world decision making.
Feedback	Provide remedial information.	Feedback in terms of the natural consequences of playing the game.

Cited from Baesley (2004)

The tutorial created for the digital version of 'Kingdom Builder' utilizes many of the design specifications defined by Thiagarajan (1993). The presentation in the tutorial could directly be taken from Thiagarajan (1993) paper, as it starts by presenting the participant with only a small part of the rules, and then having the participant perform the action defined by the rule. The tutorial would then present a new rule that would expand on the previous rule, and then have the participant perform that action. In this way having the participant use the same action learned in the beginning of the tutorial, just implemented in a different way. The tutorial then ends with the player having no restrictions on what they are allowed to do, as long as they comply with the rules of the game. The tutorial also presents the player for a less complicated and a low fidelity view of 'Kingdom Builder'. Here the participant have an already defined path. The guidance given to the participant starts off having hints for how every Settlement should be placed. In the last turn of the tutorial there are no hints given, only the regular hints given during normal gameplays. There are no use of additional motivators. Rules given to the participants start being about placement of the Settlements, but diverges later in the tutorial into 'Location Tiles' and scoring. The missing elements from the tutorial, that Thiagarajan describes, might have improved the tutorial.

5.3. What can this research supplement

This study will try to give a comparison to how digital tutorials and physical manuals differ in learnability, memorability, and engagement. Many have investigated the premise of the two separately (Gobet, Retschitzki, & Voogt, 2004), but I found no study that compared the two with each other. This study will also try to look into digital tutorials for tabletop games as there seems to be no study at the time looking into tutorials for tabletop games. This might be because no new study could be found, that research learning the basics of tabletop games, since the beginning of digital tutorials in modern tabletop games. The first digital modern tabletop game found, is 'Catan - The Computer Game' from 2009. I found that there are many people trying to make augmented tabletop games still using physical manuals (Benford, Magerkurth, & Ljungstrand, 2005), (Magerkurth, Cheok, Mandryk, & Nilsen, 2005) (Magerkurth, Memisoglu, Engelke, & Streitz, 2004) (Magerkurth, Stenzel, & Prante, 2003).

5.4. Found areas of interest

From the previously presented studies different areas of interest within the terms learnability, memorability and engagement that can be investigated. Below a chart have be created, showing the different areas of interest, followed by the studies that shows interest in the areas. These are the areas of interest that will be used during the investigations.

	Area of interest
Learnability	Amount of rules understood immediately (Natoli, 2014) & (Houser & DeLoach, 1996, 1998) & (Thiagarajan, 1993) Time spent to learn the game (Natoli, 2014) & (Houser & DeLoach, 1996, 1998) Score compared to previous experience (Gobet, Retschitzki, & Voogt, 2004)
Memorability	Time spent playing the game (Natoli, 2014) Amount of errors performed (Natoli, 2014) Ability to remember the rules(Natoli, 2014) & (Gobet, Retschitzki, & Voogt, 2004)
Engagement	Participant satisfaction after game (Natoli, 2014) Participant engagement during session (Prensky, 2001a, 2001b, 2003) & (Thiagarajan, 1993) & (Csikszentmihalyi, 1997) Think digital learning is better than physical (Prensky, 2001a, 2001b, 2003) & (Jenkins, 2002) & (Andersen et al., 2012)

6. Investigation 1.0

In the next chapter the method of how investigation 1.0 was conducted, will be presented.

6.1. Finding participants

The method used for finding participants with no previous experience with 'Kingdom Builder' for the case study was done through Facebook. A questionnaire (see appendix 1) was shared on Facebook. Other than sharing it on my page, people I knew also shared it and it was put in many 'Facebook Groups', that might show interest in the study. The group that provided the most participants was a local tabletop cafe (Aalborg Brætspilscafé), who shared the post to its guests. From the questionnaire I could find people that had not played 'Kingdom Builder' and therefore would be eligible for joining the investigation.
The questionnaire was submitted by 49 possible participants. In the questionnaire they defined what time of day suited them the best, and if it should be a weekday or a weekend. One of the possible participants was not viable to participate, due to his previous experience with 'Kingdom Builder'. The next step was to call each possible participant to arrange the time and date, that fitted them the best. I would present them with the dates and times, other participants had already planned to come and where there was not already three participants signed up.

It ended up being 11 sessions over a two week period, where most sessions were held during the first week. All sessions were booked to have three people, but during the investigation period some people called to cancel their session. This concluded that some sessions would be handled with only two people.
A possible source of error are that the same participant joined in the first two sessions. This is due to the fact one participant canceled in the first session. To ensure in the beginning that the session could be completed, a backup that already had a session planned the next day was called in, to join in the first session. The next day during the session the backup participant was asked to be more passive. This was again to ensure there were three participants in the session. The backup participant are numbered 1 and 4 in the dataset (see appendix 3).

6.2. Reason behind the choice of 'Kingdom Builder'

When looking for tabletop games to use during this study, many factors had to be taken into consideration.
First of all was the need for a digital version of the game that already existed. It also had to meet a certain standard, where participants would be able to play the digital version together on a single tablet, and for the game to follow the exact same rules, as its physical counterpart. The original intend of this study was to create a digital version of a tabletop game. This would create the possibility of receiving more data points from the investigations, as it could be programed directly into the digital version. The implementation of a digital tabletop game was not within the scope of the study, due to limited time and manpower. Therefore instead an already implemented digital tabletop game would be selected.
Secondly the digital version needed to have a tutorial included, that would teach the rules of the game in an interactive manner.
Thirdly the game should be simple enough for inexperienced players to be able to learn the rules of the game, without it overwhelming them. The speed of gameplay for the game should also be fast enough, to ensure that participants of the investigation would not be discouraged to join, if the session would carry on for too long.
When looking through the different tabletop games that was created in a digital version, a pattern started to emerge. It was found that mainly european style tabletop games were made in a digital format. From looking at the different games available, on the different application stores, it came down to be a choice between Carcassonne and 'Kingdom Builder'. Both of them are made by differ-

ent publishers but the digital version of each of them are made by the same publisher that created the original physical tabletop games, and had a tutorial written by the same people. This meant that the tutorial was written using the same terms and style of writing as the physical manual. This way, the possible variable of, the variation from the physical version to the digital version of 'Kingdom Builder', would not be a problem. Therefore this study would then concentrate on the participants' understanding of the rules.
The fourth factor is that the game needs to use simple game mechanics, that can easily be learned. The game will, though, also need to have a greater depth in complexity. Carcassone and 'Kingdom Builder' both utilizes simple game mechanics and both games have a great strategic complexity. The simple game mechanics makes it possible for participants to see the greater depth in the game quickly.
Both games also had a short playtime between half an hour to 45 minutes. This playtime is for four participants for each game. For this study number of participants is reduced to three participants thus reducing the playtime by a factor of ¼.
A fifth factor that played into the choice of game was the game could be played by only two participants. This happened to be a great choice since some participants would cancel just a few minutes before the session would begin and no replacement could be found.

Because the investigation would look for learnability of the tabletop game the participants have not played before or learned the rules from other sources. In the questionnaire the participants was presented with a list of games and they were asked to indicate what games they had played before. In the list Carcassonne and 'Kingdom Builder' was hidden to ensure that participants would not know what game they would play during the session, as some participants would maybe read the rules beforehand. This gave a clear view that 'Kingdom Builder' was the only option for the investigation, as more than 60% of all the responses had played Carcassonne before, and only one response had played Kingdom builder.

6.3. Sessions

The ideal is to have the same amount of physical and digital sessions. To ensure this, sessions was done alternating between a session with a physical version, and a session with a digital version. The alternation ensure that if two or more participants canceled and replacements were not able to be found, there would still be a nearly even split. This means that all odd numbered sessions are physical and all even numbered are digital sessions.
The interview guide made for the physical version is included as appendix 2. The digital version is identical, except for the introduction telling them they will play the digital game, and the inclusion of the digital game in the asset section. The session is divided into 4 segments. First is the introduction to the investigation where the study is being presented to the participants. The participants are then asked to sign a contract, accepting being filmed and the data can be used for this study, as long as they are being kept anonymous. The game is then presented by name and they are asked again if they have played the game, or have in other ways been presented to the game, before this investigation.
The game is then placed on the table between them and they are told that the manual is included in the box. When setting up the board the facilitator presents the specifications of the random elements chosen beforehand by the facilitator, this is done to ensure less variables in the data.
When all players have agreed they know the rules a game session is started. Through the gameplay session the facilitator is not allowed to interact with the players, except if players have problems outside of the game. This can as an example be needing the toilet or helping translating words from english to danish, as this is not an investigation in the participants lingual abilities but how they learn the game.
After the game session the facilitator have a short semi structured interview asking how they found the experience of both learning and playing the game. Then if they would want to play it again, and recommend the game to friends.

For the setup the facilitator was placed as far to the side while still able to observe the game, this was done to avoid intervening or distracting the participants. The camera was placed to focus mostly on the game and not the participants, as their movements was not of importance in the study. For the digital game sessions the tablet was placed in place of the physical game. On the tablet used during the sessions, a program called 'illos' was used to record the screen as the camera had problems recording the screen for proper playback. (Rogers, Sharp, & Preece, 2011)

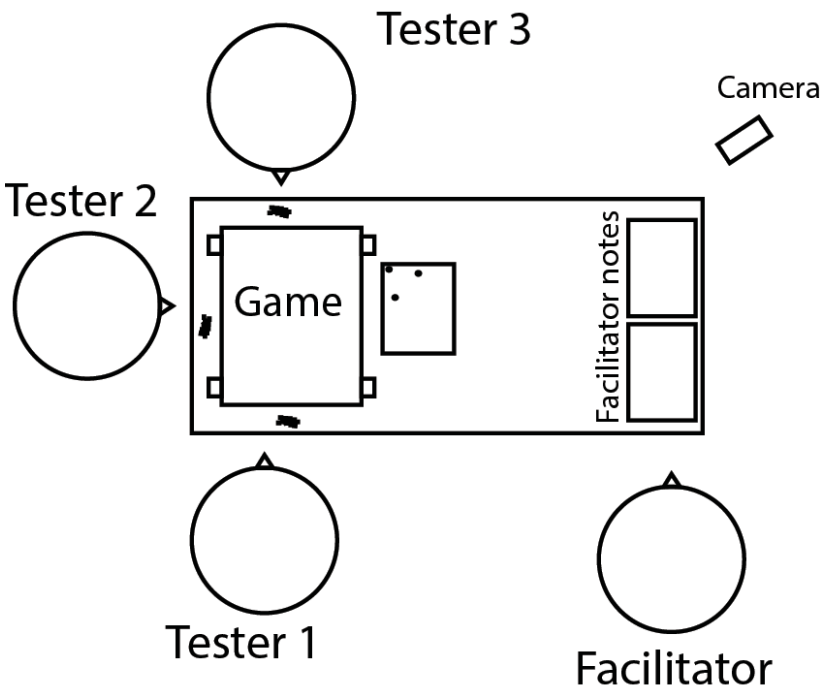

Illustration 10 - Investigation setup for physical game session.

6.4. Data analysis

For the purpose of analysing the video it was imported into ‘Adobe Premiere Pro’. In the video from the digital sessions, an overlay was created showing the tablet screen, using the ‘illos’ recording. Markers was placed in the video to give a better overview. ‘Adobe Premiere Pro’ was chosen because of previous experience with the software. Moreover its ability to manipulate the video in many ways, including using the scroll wheel on the mouse to jump one frame at a time to get more precise time stamps in the data, noted from the video.

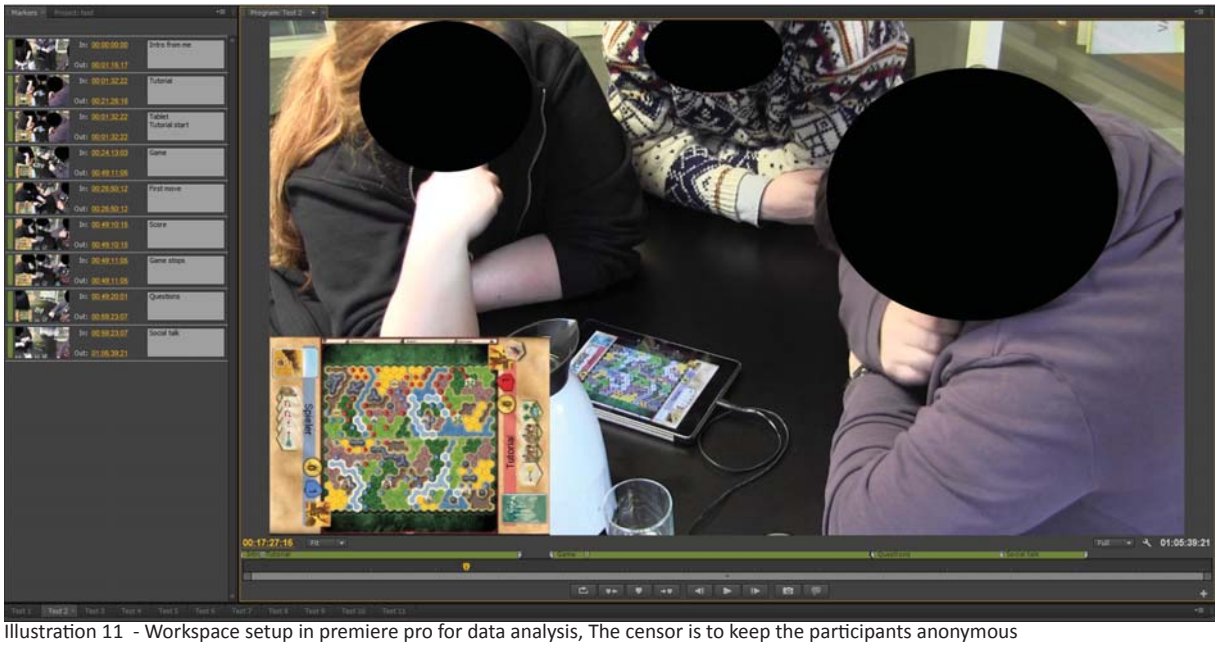

Illustration 11 - Workspace setup in premiere pro for data analysis, The censor is to keep the participants anonymous

	A	B	C	D	E	F	G
1	Test	Start time	End time	Type	Participant	Description	Comment
2	1	00:00:52	00:17:24	Learning game	3	opens rule book	start of time for learning
3	1	00:01:10	00:13:04	Learning game	3	reads rules aloude	

Illustration 12 - First two datapoints from google sheets

All data noted from the video analysis was written in a ‘Google Sheets’. Each data point include what session it is, start and end time in the video, what type of interaction it is, what participant it is that preform the action, and then a description. There is also a field reserved for comments to further describe what happened if it is needed. (Rogers, Sharp, & Preece, 2011)

The data consist of a mixture of qualitative and quantitative data. The qualitative data consist of the Interview and the video recording. The quantitative data consist of the questionnaire participants had answered prior to the investigation session and the final score of the game. To give a better overview and to easier compare data from different investigations, most of the qualitative data have been standardised. This is done by grouping different interaction depending on what kind of interaction it is.

Group	**Decription**
Illegal move	Participants performing a move that is against the rules of 'Kingdom Builder'
Looking up rules	Participants after the initial learning phase have to look up rules either in the manual or in the digital version
Discussing rule	Participants discuss how a rule is to be understood to create a common understanding between all parties
Answer to question	Participant answer a question set forth by the facilitator
Learning game	For noting down events and interactions participants perform throughout the learning phase
Interference from facilitator	For noting down when the facilitator interacts with the participants
Gameplay	For noting the start and end time of the gameplay session

The use of qualitative data, instead of only using quantitative data, is that qualitative data can show trends, that will not be clear using a quantitative method. This was also shown in the interview when participants was asked if they wanted the manual or the tutorial to learn the game. Some participants would add reasoning behind their choice and include what would make them change decision.

7. Investigation 2.0

After the first Investigation and data analysis was concluded, a new area of interest was found. Due to the way the digital version of 'Kingdom Builder' is constructed, it is not possible to perform errors during gameplay. This interfered with one of the factors for measuring memorability (Natoli, 2014). To correct this, an investigation where participants would play through the tutorial on the tablet, and then play the physical game. Players would not have the guiding hand of the tablet, helping them play the game and remember the rules. Another interesting area that was found after the investigation, was the participants' fascination of bridges. This was not part of the interview process during the original investigation, but could be asked during this second investigation.
This will only be a pilot investigation to figure out if further study in the subject is needed. Participants was found through 'Aalborg Brætspilscafé's Facebook Group'. Two groups of two participants each, was chosen to be part of the investigation. One group consisted of the volunteer workers in the café. They have a big back catalog from playing many different tabletop games. The other group consisted of guests in the café that had less experience with tabletop games.
This time, instead of recording the session, the facilitator had a chart with all the different data points, that was used for analysing the data from the first investigation, with the addition of asking participants about the bridges. This was done since this was a pilot investigation and is created to see if further investigation is needed.

8. Data Analysis

In this chapter the data gathered during investigation 1.0 and 2.0 will be analysed, using the areas of interest found as shown in the literature review (see 5.4). During this chapter, data will be presented from both investigations firstly from investigation 1.0 where an analysis of the data will follow. After that data from the same area of interest will be shown from investigation 2.0 with an analysis of the data. Then the next area of interest will be analysed in the same manner and so on.

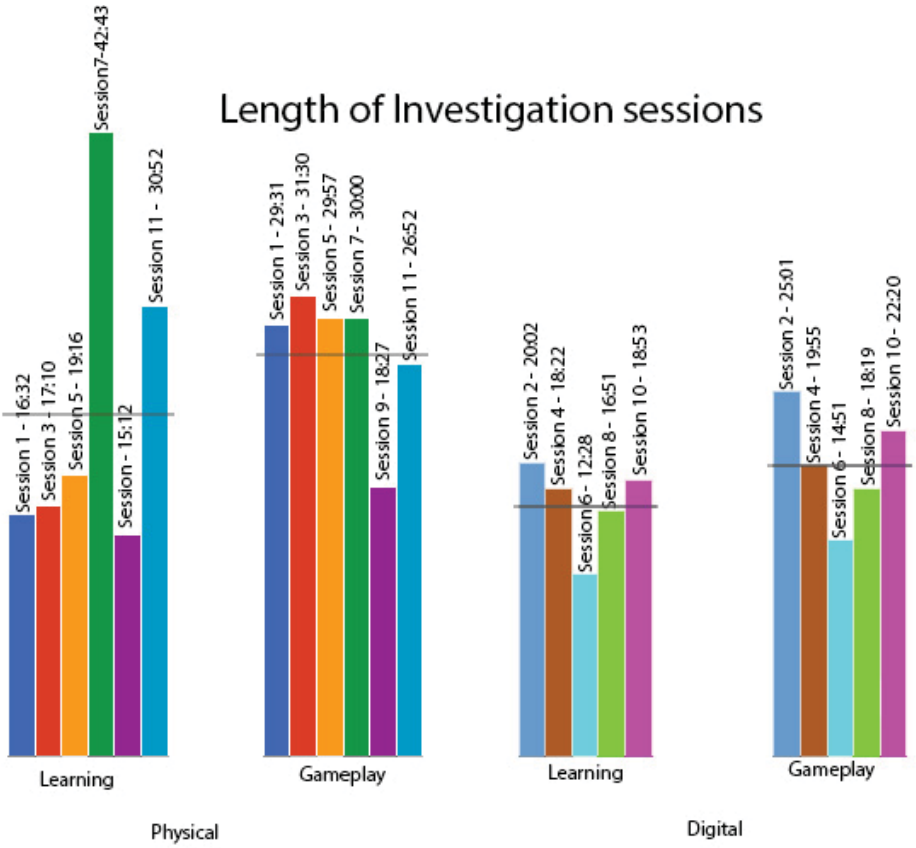

illustration 13 - Investigation 1.0 - Chart showing the length of each session devided into a learning phase and a gameplay phase

Looking at Natoli's factor of efficiency (2014) he describes it as the user's speed in both learning the product and using the product. This can be examined in the data gathered during the two investigations. By looking at the amount of time participants spent, during the learning phase, one factor of learnability can be measured. Moreover by looking at the time spent playing the game, one factor of the amount of memorability in 'Kingdom Builder' can be found. For the amount of time spent during the gameplay phase, there have to be taken into account that some participants will want to strategies and optimize their play.

When looking at the amount of time participants used, in order to learn the rules in the sense of them reading the manual or playing through the tutorial, then in the digital sessions there is a small variation in the time spent playing the tutorial, but there is no significant variation between each session. In the physical version there is a big variation in how much time participants spent learning the game mechanics. The big outliers are session 7 and 11. When looking at the average of learning, without these two outliers in the physical version, the average becomes almost the same as the digital version.

The amount of time played tells a different story. Here it is clear to see that the digital version helps the participants to get through a game at a much faster pace, than in the physical version where the fastest game are only slightly faster, than the average of the digital version. Whereas all other sessions in the physical version are slower than even the slowest digital playthrough. There seems to be a direct correlation between the amount of time used during the tutorial, and the time used playing

a full session of the game in the digital version of Kingdom builder. A possible answer to the fast playtime for session 9 can be that there were only two participants, compared to session 1, 3, and 5. There are also only two participants in session 7 and 11, but because of their extensive time spent reading the manual, other factors might play in for the long playtime.

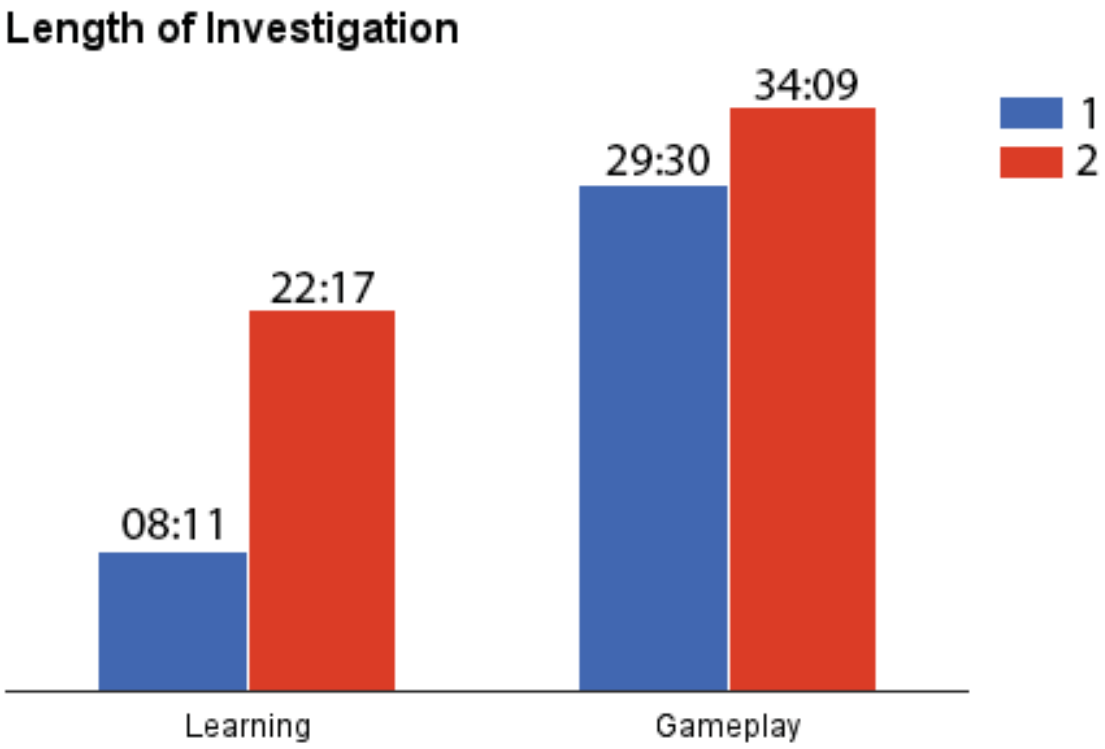

illustration 14 - Investigation 2.0 - Chart showing the length of each session devided into a learning phase and a gameplay phase

Looking at the amount of time participants spent learning the game through the digital tutorial, there is a big difference between the two sessions. In the first session both participants joined together to finish the tutorial, where in the second session the participants decided to go through the tutorial separately. This doubled the second session's learning time, both participants also had problems figuring out, how the zoom functions and the highlight system in the tutorial functioned. This increased their time to complete the tutorial. Compared to the previous investigation the second session only spent two minutes longer, than the slowest session in the previous investigation. This can be seen as they would not communicate with each other throughout the tutorial, and would skip the final step of optimizing the amount of points achieved. The first session was 4 minutes faster, than the fastest session in investigation 1.0. The two participants of the first session would quickly read the text box and instantly know what to do, to go further in the tutorial.
Both gameplay sessions, during this investigation, was around the same amount of time spent in the sessions with three participants, in the previous investigation. This might come from participants needed to translate the visuals from the digital version to the physical board. Furthermore having to read the rules that describe the functionality of the different 'Location Tiles' and 'Kingdom Builder Cards', as those where not part of the tutorial.

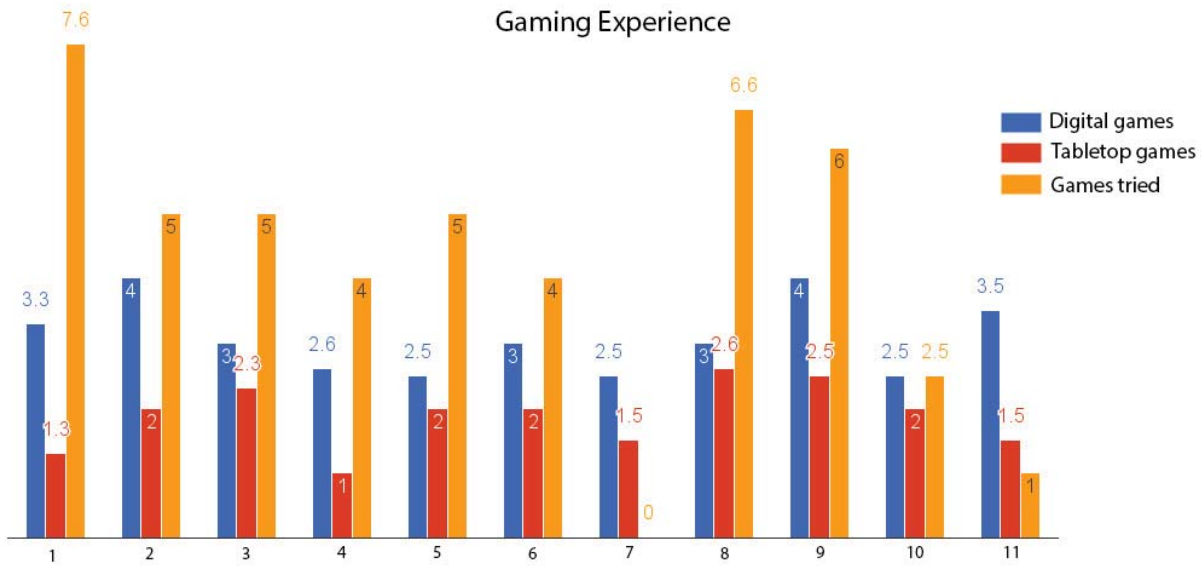

illustration 15 - Investigation 1.0 - Chart showing the avarage game experience for each session

This chart shows the average value of gaming experience taken from the questionnaire answered by participants. The values are defined between the numbers 0 - 4, 0 being 'never playing' and 4 being 'playing every day'. The data can be found in appendix 3. When looking at this chart, there might be an explanation for why there are such a big difference, in the time it took session 7 and 11 to read the manual and start playing. Looking at how many games they have tried, this is taken from a list provided by the facilitator, consisting of the most common and popular tabletop titles. These can be found in the questionnaire in appendix 1. The participants in session 7 and 11 had little to no experience playing any of the games. This would lead to the participants having problems with the normal vocabulary used in tabletop game manuals. This can also be seen in the video, where each point is discussed at length so they are able to understand everything. The opposite effect can also be seen in session 1 and 9 that are the fastest at reading the manual, and they also have the biggest library of games previously tried.
In session 7, 9, and 11 there were only two participants, therefore the time used playing the game should be comparable. Nevertheless in session 7 and 11, playing the game was much slower, (around the same amount of time as in a game with three participants) than in session 9. This must be due to the lack of experience for the two participants in session 7 and 11.
The increased amount of time spent playing can also be found in session 10. Session 10 is a digital session with only two participants. The two participants in the session spent more time than the average playtime of three participants for playing the digital version. They also lack in a general tabletop experience.

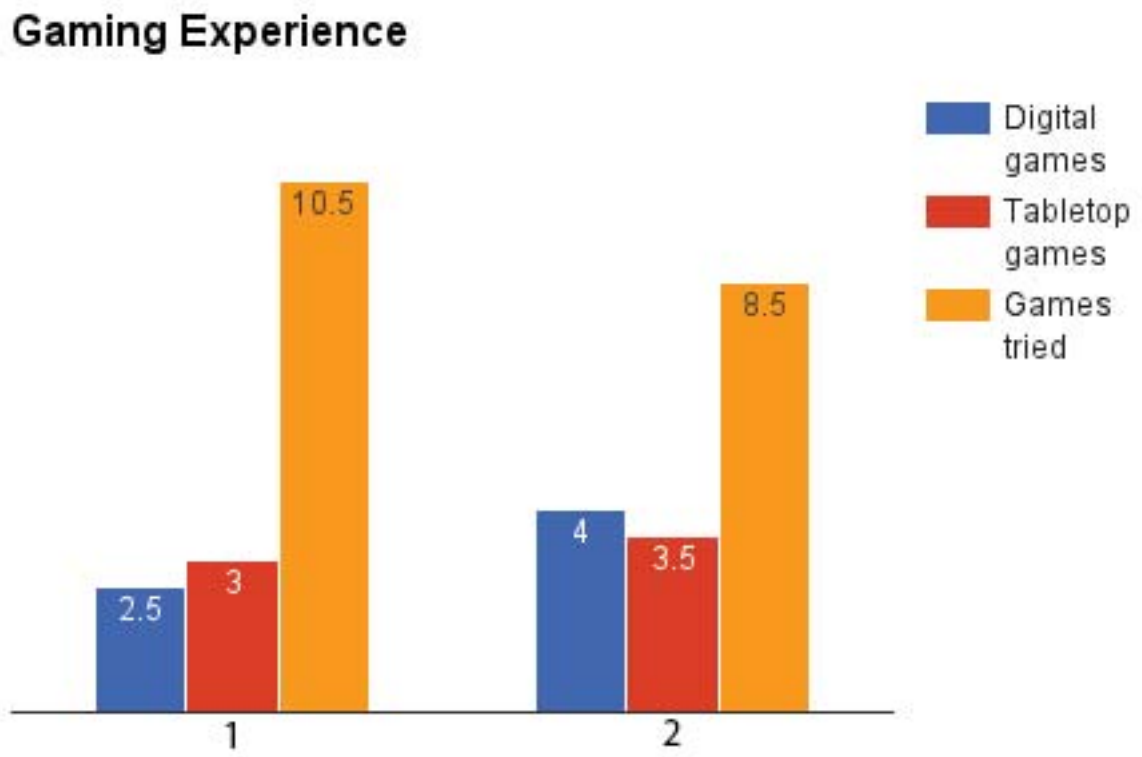

illustration 16 - Investigation 2.0 - Chart showing the avarage game experience for each session

From this chart it is more clear why session 1, in investigation 2.0, was extremely fast at completing the tutorial since they had tried more games than any other session. One participant had tried every game on the list given by the facilitator, other than 'Kingdom Builder'. The other participant only missed one other game on the list. The experience also explains, partly, how session 2 could run through the tutorial twice in just four minutes more than sessions in investigation 1.0. They have great experience in both playing physical and digital games and have played a great collection of tabletop games, previously.

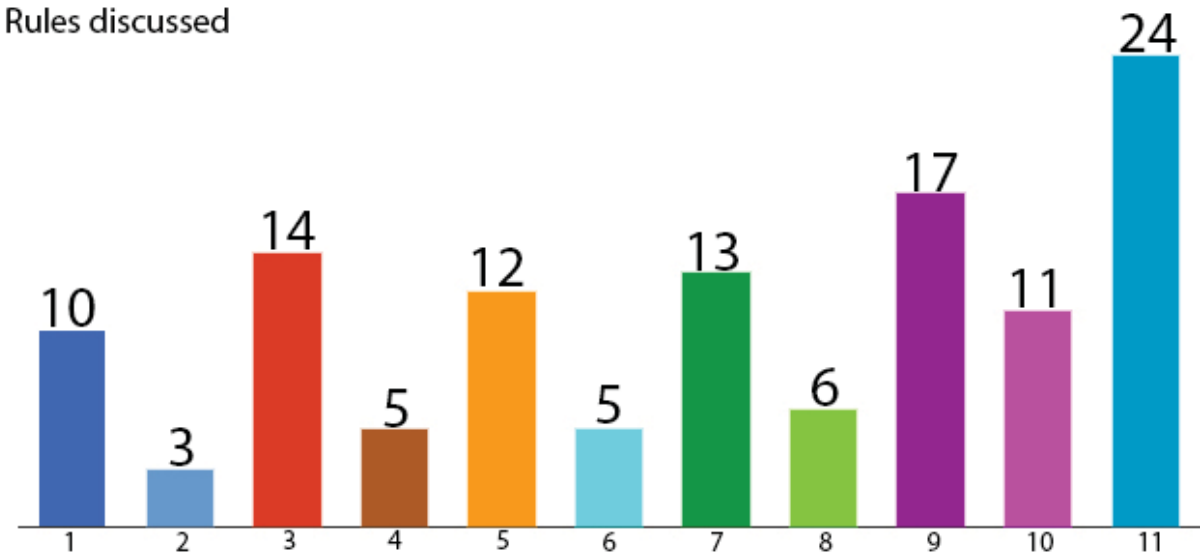

illustration 17 - Investigation 1.0 - Chart showing the amount of times rules were discussed

Looking at the amount of times participants discuss the rules of 'Kingdom Builder' can help to show, how many of the rules the participants understood immediately. This will show the learnability of the game (Natoli, 2014).

When looking at how much participants discussed rules, both during learning the game and their gameplay session. It is clear to see that there are less discussions in the digital versions than in the physical versions. This can also be seen in the video where in digital sessions the participants discuss how to understand the text in the tutorial, so they have the same understanding. Here it can also be seen that experience have an influence, on how much people discuss the rules. whereas in session 10 the participants have little experience with tabletop games, and therefore need to make sure they all know how the game functions.

In the physical sessions you would think that session 7 would have the most discussions about the ruleset, as they were the participants who used the most time in their learning and gameplay phase. Though this is not the case. The reason behind the low amount of discussions can be seen in the video/investigation data in appendix 3. Instead of having many small discussions about every rule, they use the extra time while reading the manual to discuss every part of the manual, and only have short discussions during the gameplay, for the rules they forgot. On average they spend longer time in their discussions while reading the manual than most other participants. This is the reason behind their low amount of discussions. This also helps to explain why they spend so much more time learning the game, than other sessions.

Session 11 are very different in the way they discuss compared to the participants in session 7. Here instead of having long discussions, they have many 10-20 seconds discussions about small sections of the rules both when reading the manual but also during gameplay. This would be the main reason behind, them having about double the amount of discussions than most of the other sessions. In session 11 there is one big outlier in length of discussion and that is when they were setting up the board. They were presented with the names and position of the game boards, and spent almost 10 minutes figuring out how to setup the board specified. This is the main reason behind their extensively long learning phase of their session.

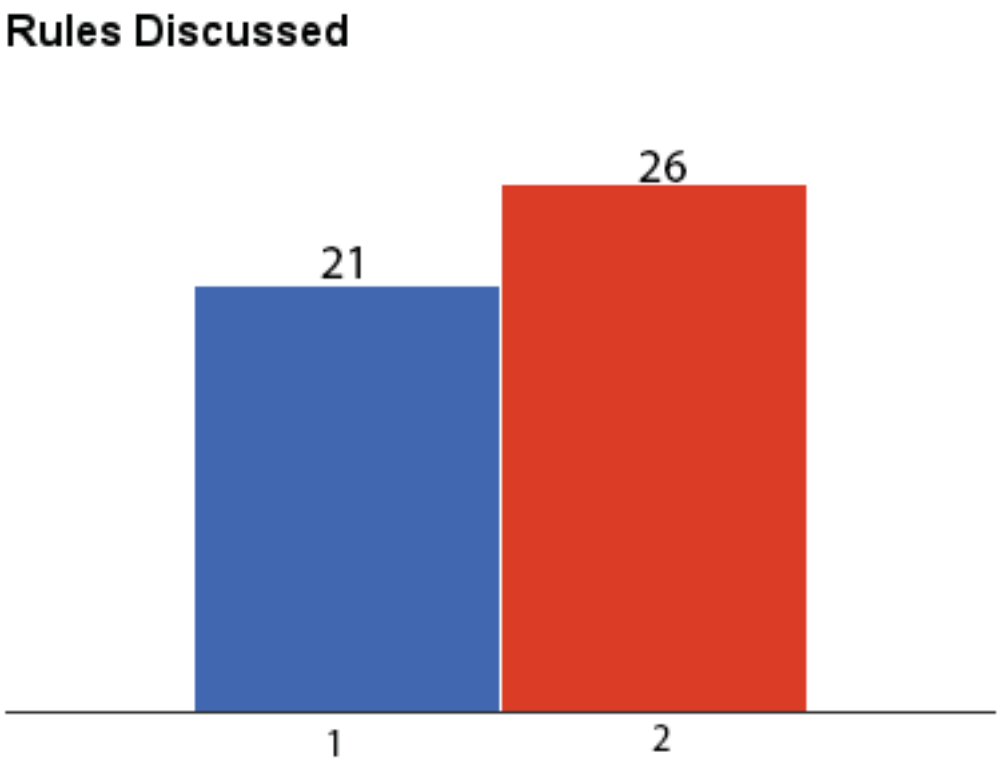

illustration 18 - Investigation 2.0 - Chart showing the amount of times rules were discussed

The amount of discussions happened mostly in the beginning of the gameplay part of the session. This was mainly because participants needed to agree on how to convert the rules they had just been told, through the tutorial into the physical version. The fact that the participants discussed more than double the average amount of the previous investigation, can come down to some rules that was not described in the tutorial that is essential to the game. These are rules as 'Terrain Cards' where the participant have to draw a card and then play it when it is his/hers turn. This is not described in the tutorial, since it is a game mechanic that is handled completely by the tablet, and the participants have no way to interact with it. This is one of the reasons behind the prolonged gameplay time for the two sessions in investigation 2.0. This required participants to discuss the rules that was described to be understood easily in the digital version, but not described in such detail that it could be transferred directly to the physical version.

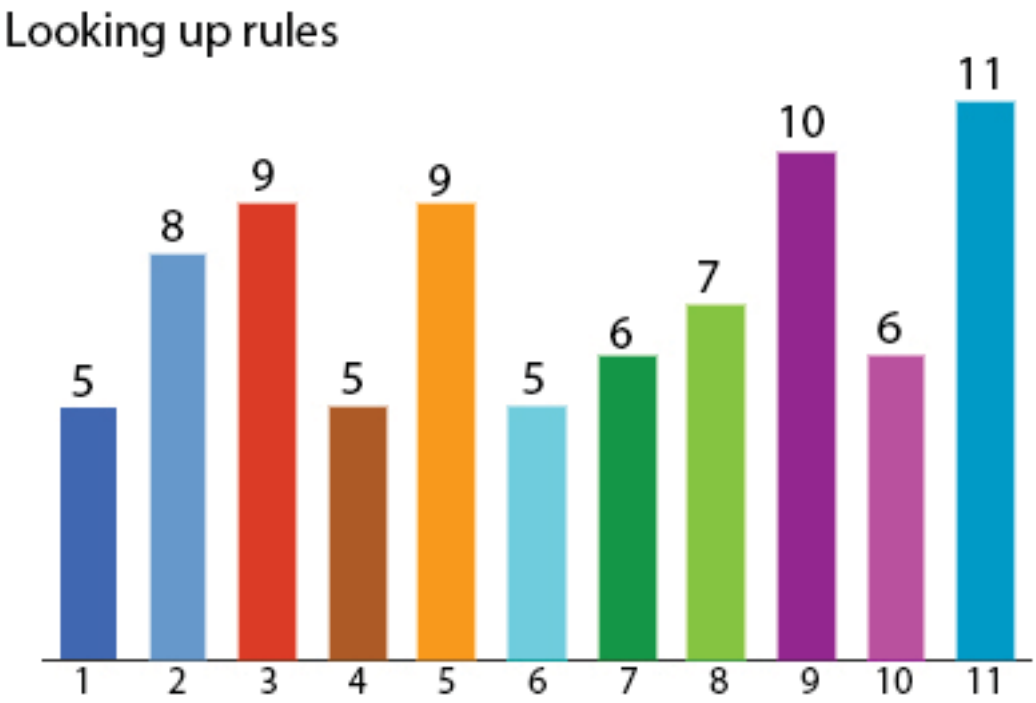

illustration 19 - Investigation 1.0 - Chart showing the amount of times rules were Looked up after gameplay session starts

Looking at the amount of times participants looked up rules, can help to show how often the participants fail to remember the rules of the game, and therefore show the memorability of the game (Natoli, 2014).

Investigation 19 compares the amount of times participants looked up rules during the gameplay session of the investigation. Looking up rules is defined in the physical version as reading in the manual. In the digital version looking up rules are defined as participants reading the 'Kingdom Builder Cards' or clicking the 'Location Hexes' to look up the rules for the individual 'Location Tiles'. Curiously, when looking at the difference between the digital and physical sessions, all physical sessions have participants look up rules far less than they discuss rules. In the digital version participants looked up rules, in general, the same amount or more than they discussed rules, with the exception of session 10, where the participants looked up rules far less than they discussed.

From looking through the video, it can be seen, in the digital sessions, that participants instead of looking up rules together, most participants look up rules on their own, and do not let other people read it before closing the textbox. This helps to give a very anti social environment, in the session where participants do not communicate while playing, or even during the tutorial only when it is needed. One participant in session 4 even noticed during the questions phase, that the participant had not even looked at the other participants during the entire gameplay, session but only at the tablet.

In the physical sessions on average the participants look up more rules than in the digital version. This would mainly be because of how the digital version is played, where illegal moves are not allowed, and every possible move is highlighted. The digital version is implemented this way, to ensure that rules like this does not have to looked up. When looking at the video it can be seen that participants of the physical sessions would look up rules during a discussion of the rule, and the manual would help them clarify how the rule should be understood.

The low amount of times participants looked up rules in session 7, is most likely due to their long learning phase, where they used the extra time, in the learning phase, before starting the game. In other sessions people wanted to start playing as soon as possible.

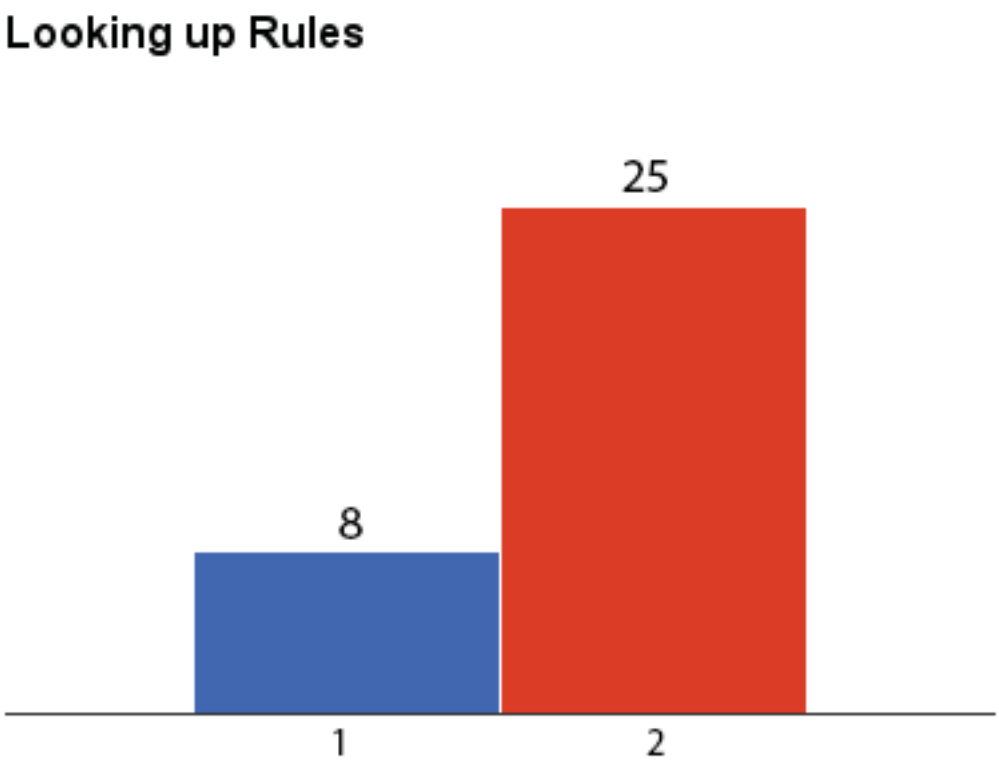

illustration 20 - Investigation 2.0 - Chart showing the amount of times rules were Looked up after gameplay session starts

During the gameplay session participants of investigation 2.0 was given the back of the manual. This is the pages that include the overview of the different 'Kingdom Builder Cards' and 'Location Tiles', the reason behind including this is because the tutorial does not go through every different tile or card. This was done so participants had a chance of looking up the rules just as in the digital version of the game. Here participants are able to click the different tiles or cards and read the rules of how they function, just as in the manual. They also had the tablet next to the physical board so they could play through the tutorial again if they needed to look up rules they were taught previously. During session 1 the rules that was looked up was the different 'Location Tiles' and 'Kingdom Builder Cards' that was included in the game they were playing, and then they set, the tablet with the tutorial and the manual, to the side and played the game, only needing to discuss the rules and not to look up the rules again. This can be because of their experience playing many different games. They also work as volunteers at the boardgamecafé in which the investigation was held. Here they have to learn many games, and be able to convey the rules to visitors of the café, this would give them more practice in learning games, and going through them quickly.
During the second session participants had many problems transferring the rules from the digital format to the physical game. This lead to them playing through the tutorial numerous times, just to read a single textbox given in the tutorial. This can also explain the much longer play time, as they would sometimes spend one to two minutes just to wait for one of the participants to restart the tutorial and go through it, till the textbox they needed to read.

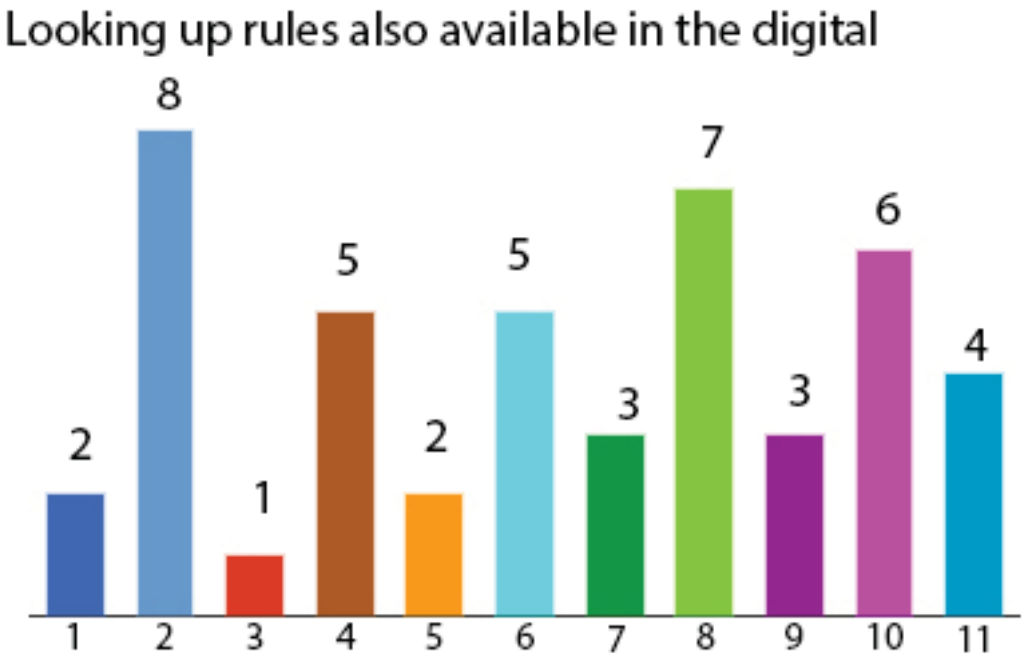

illustration 21 - Investigation 1.0 - Chart showing the amount of times rules were Looked up after gameplay session starts also available in the digital version

This chart use the same data from the previous area of interest (see illustration 19). The only difference is that all rules looked up, that can only be found in the manual, and not while playing a game in the digital version, have been filtered out. The problem with the digital version and having a tutorial is that after a game session is started, only the rules for 'Location Tiles' and the 'Kingdom Builder Cards' can be looked up.

When looking at the data here, the antisocial trait of the digital version is more clear. In the physical version participants talk about the rules and look them up together. In the digital version the same rules are looked up multiple times and even sometimes right after each other, because some participants did not get to look at the rule, before it was closed again.

Though the low amount of rules looked up can also come from the fact, that participants of the physical version of 'Kingdom Builder' would set up the game board while reading the manual, and would get to know what location tiles was used in the game, they were going to play. The participants would already have looked up the rules for how the different location tiles would function. This was the case in most of the physical sessions. But it still shows that participants had a need to look up the function of the 'Location Tiles' and 'Castle Hexes'. The need for still looking up 'Location Tile' and 'Castle Hexes' shows that the physical version could use some improvement in memorability of the rules.

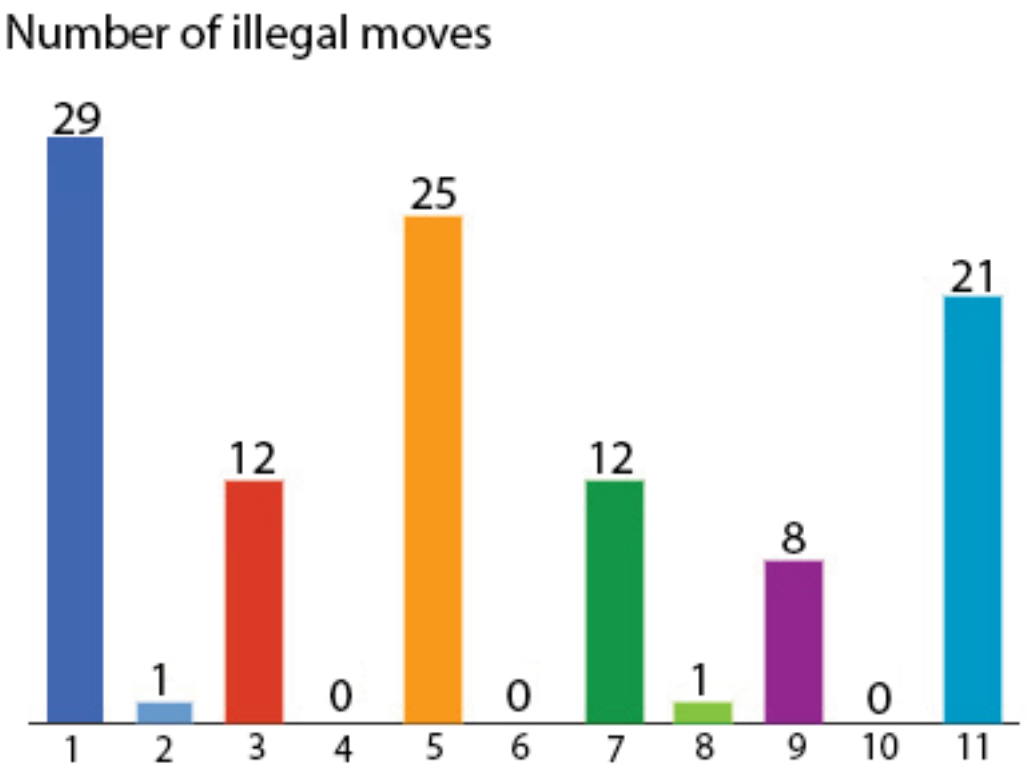

illustration 22 - Investigation 1.0 - Chart showing the amount of Illegal moves performed

Natoli (2014) use his term of errors as a definition of the memorability of a product. By looking at the amount of illegal moves(errors) the participants perform, this can show a part of memorability in 'Kingdom Builder'.
When looking at the number of illegal moves made by participants, which is the biggest difference between the digital and physical version of 'Kingdom Builder'. In the physical version the only thing standing between the participant doing an illegal move or not, are all the participants understanding of the rules from reading a manual. In the digital version no illegal move is possible. The two illegal moves registered are illegal moves participants tried to do, but the tablet prevented the participant from performing the move.
The amount of illegal moves can be linked to how often participants play tabletop games as seen in illustration 15. It can be seen that in sessions where participants play more than 2-3 times a month, less illegal moves are made. Again in session 7, where the participants had almost no experience, they still played the game with a small amount of illegal moves. This can be explained from their extremely long learning phase, and from them discussing the rules till they understood them almost as intended.
The amount of times participants discussed rules did also have an impact on how many illegal moves were performed. Here the exception is in session 11. Even though the participants discussed the most, they still made made a lot of illegal moves. Otherwise it can be seen that the more people discuss the less mistakes are made.
This also shows one of the weaknesses of investigation 1.0, constructed for the purpose of this study. There are no way of comparing the memorability of the two ways of learning (manual and tutorial) by looking at the amount of illegal moves made in the gameplay. This is because participants were not able to perform illegal moves in the digital version.

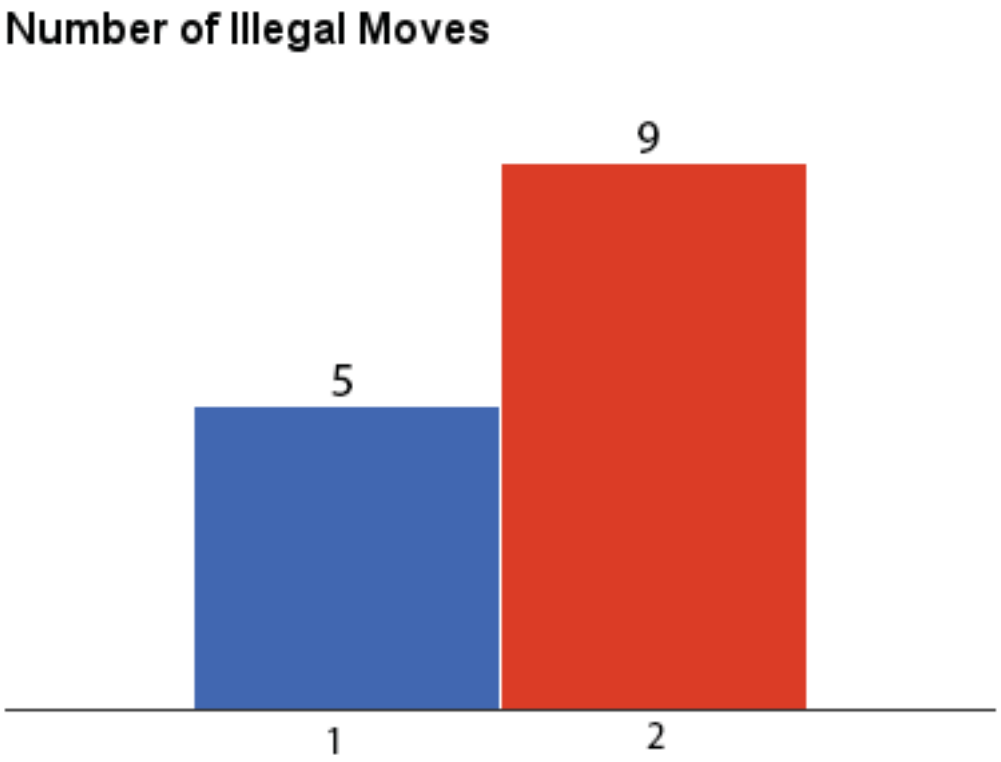

illustration 23 - Investigation 2.0 - Chart showing the amount of Illegal moves performed

During session 1 the participants was very meticulous with following the rules of the game. They sometimes tried to bend the rules to the extreme, to see how different strategies could be formed in the game, and how to optimise points. This lead to them sometimes making illegal moves. Curiously whenever they would perform an illegal move, either the participant that performed the move, or the other participant would catch on to the fact that it was an illegal move, and it would be corrected to a legal move. There was no exception. Sometimes it would be during the other participants turn, that the illegal move would be found, but it was always corrected to follow the rules. This is also the reason behind the many discussions that the participants would make.
The second session was a different story more in line with the previous investigation. The illegal moves that was made, was due to a misunderstanding in the rules. This was most likely a translation error, translating game mechanics from the digital to the physical medium. The participants did follow the building rules, maybe in a bit too aggressive manner, as they decided that all three settlement placed, during a mandatory action, had to be placed adjacent, as that was how it was shown in the tutorial.

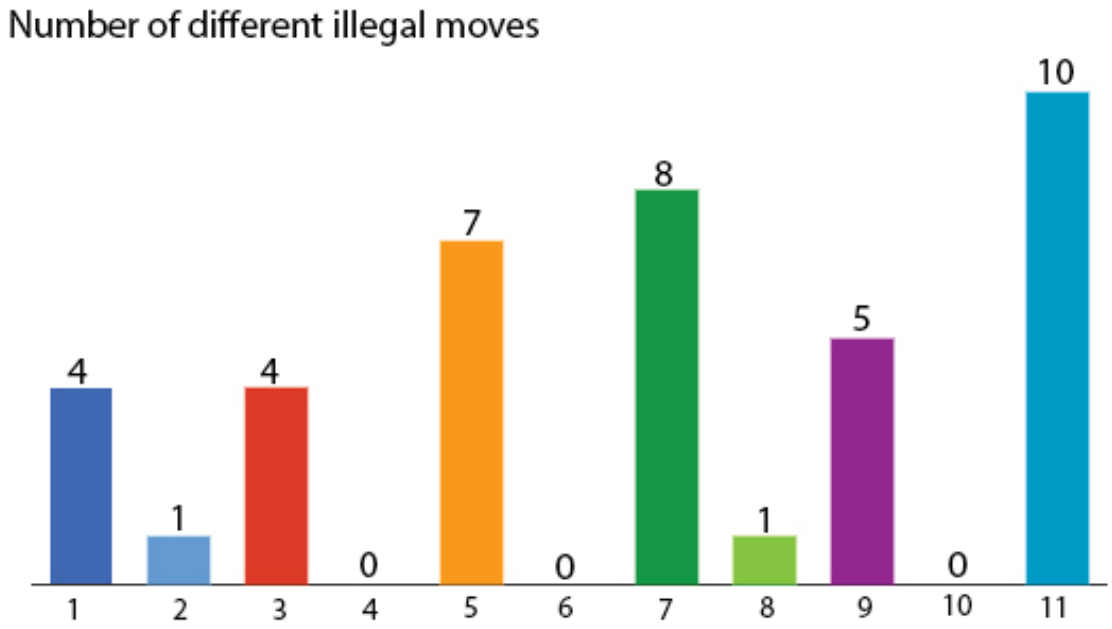

illustration 24 - Investigation 1.0 - Chart showing the amount of different Illegal moves performed

Instead of looking at how many times participants performed an illegal move, the amount of different illegal moves can be observed. The reason behind the difference between the amount of times illegal moves are performed, and the different types of illegal moves, is that an illegal move is made mainly because the participants have agreed that it is the way to understand the rules, and it is not just because other participants does not spot the illegal move.

This is a very different picture than the one above illustration X. In illustration X session 1 was the session with the most illegal moves performed. Now it is amongst the lowest in the physical sessions. The reason behind this is that when sitting down and reading the manual, they misunderstood four of the rules in a wrong way, and then kept doing the same illegal moves multiple times, therefore getting a high amount of illegal moves.

There is a greater problem with memorability in session 7. Instead of performing the same illegal move multiple times, they perform many different illegal moves only a few times. This shows that participants can have problems remembering the different rules and instead make them up as they go. The other participant have enough problems keeping up with what their next play should be, to notice the illegal moves. The most extreme case of this is during session 11. Here they do almost every illegal move done during all other sessions, and only do a few of them multiple times.

There are three different illegal moves that happen in more than half of all the sessions on the physical version. The first type of illegal move is not following the most important rule of the game, which is placing Settlements next to already placed Settlements. The second most common rule to break, was using a location tile the same turn as it was acquired. The last common rule was using the 'Tavern Location Tile' in a wrong manner. The 'Tavern Location Tile' allows a participant to place a Settlement at the end of an either horizontal or vertical line of at least three other Settlements owned by the participant. The rule was mainly broken in ways, where participants would place a Settlement in the end of any three Settlements they owned, it did not matter if it was a straight or curved line.

To describe the common rules which is broken, during the gameplay phase of the physical sessions, in a different way, Salen and Zimmerman (2004) discuss different types of rules they have been divided into three different categories:

1. **Constitutive rules:** These are the rules that define the core mechanical rules. They are all abstract and does not tell how players should enact the rules. By looking at 'Kingdom Builder' this kind of rules are the building rules and how scoring works.
2. **Operational rules:** These are the rules that tell the player how to play the game. These rules are often the rules found in the manual for a game. In 'Kingdom Builder' these rules are how player turns function, the setup of the game, and definitions of what each location tile and 'Kingdom Builder Cards' function is.
3. **Implicit rules:** Here the rules are the unwritten rules that you will most likely never find in the manual or tutorial that comes with a game. These rules in 'Kingdom Builder' are the idea of players being able to place settlements to block other players from gaining points. These rules more define all possibilities that players can perform given the two other categories of rules.

Of the three most common illegal moves performed one of them is a constitutive rule of placing Settlements next to already placed Settlements. The two other rules are both operational rules, as they are clearly stated in the manual and describe how specific functions of the game happen. The two categories that the three rules have been placed in define the game, by changing these rules the participants have created a different game, using the same pieces. Hereby the game is completely different if a change occurs, in the constitutive rules and the operational rules. Whereas a change in implicit rules does not imply a significant difference in how the game is played.

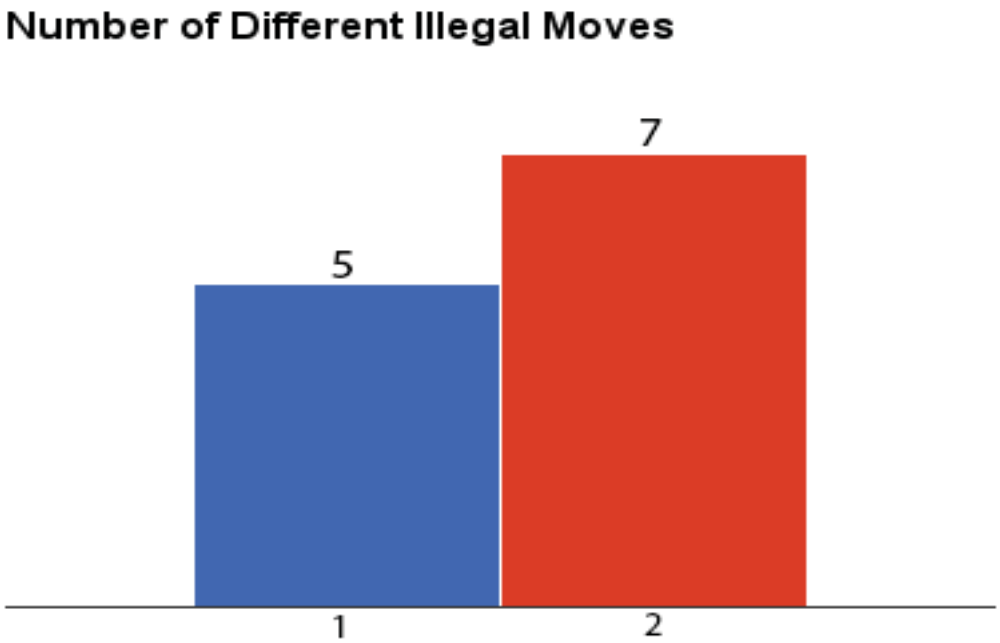

illustration 25 - Investigation 2.0 - Chart showing the amount of different Illegal moves performed

When looking at how many different illegal moves made in investigation 2.0, there are not much of a difference from the amount of illegal moves. The first session only made one illegal move to investigate the boundaries of the rule. When the boundary was found, no more illegal moves was performed. During the second session the participants had problems remembering the rules of the Farm and Oasis 'Location Tiles' used in the game. The two 'Location Tiles' was mixed up a few times during the game, and this is the reason behind the recurring illegal moves.

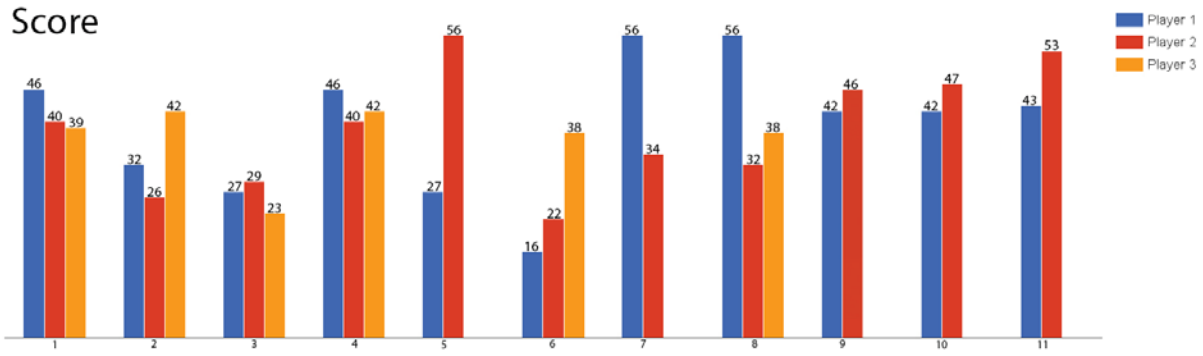

illustration 26 - Investigation 1.0 - Chart showing the Score for each participant

In many of the session participants have a very similar score. Here the difference in score would mainly be due to chance, where different participants drew terrain cards that change the possible amount of points a participant can achieve. In other games there are a significant difference in amount of points. This can again be down to chance but in a different way. Instead of trying to have a winning strategy, most participant would place settlements at random, where the rules would allow them. If Settlements are placed at random, still following the rules, the variance in score will due to chance. In some instances it can be seen in the video, that few participants would have a stronger grasp of the rules than other players. The strongest case of this, is in session 7 where participant 18 was much faster to grasp all the rules and how to use them as an advantage, both against the other participant and to gain more points.

Furthermore during session 6, a very interesting observation of a participant was seen. Here, about mid way through the gameplay session, the participant came to the realization, that some wrong choices was made, during the beginning of the game, that reduced the amount of points achievable for the rest of the game. This shows that participants evolve in their understanding of the game during the gameplay session. One of the reasons behind the very low amount of points in this session, could mainly be because of the very short amount of time both used during the tutorial and gameplay phase. The participants played the game at a speed of over double that of session 10, if looking at the time spent per participant.

There is also a big difference in score in session 5. There is a very different reason behind this, than in other sessions. Here it is due to participant 14 breaking the rules and performing illegal moves, that greatly increased how many points were possible. This shows that when two participants follow different rules the game loses balance. Although the blame can also go to the other participant that never questioned the participants illegal moves.

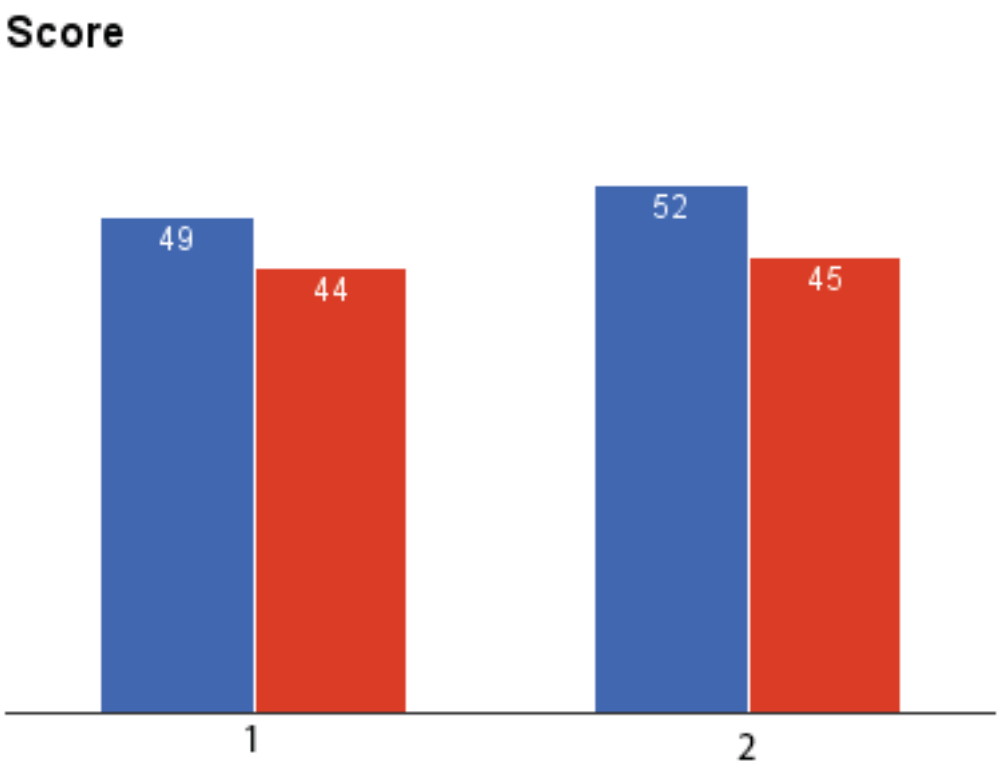

illustration 26 - Investigation 1.0 - Chart showing the Score for each participant

The participants during the two sessions was not very aggressive against each other. They divided the board in two and tried to see how they could optimize the game better. They also helped each other more with remembering the rules, and talking about it as if they did not compete. The participants all had equal skill, (see illustration 16) compared to the participant they were put up against, with only few differences between them.

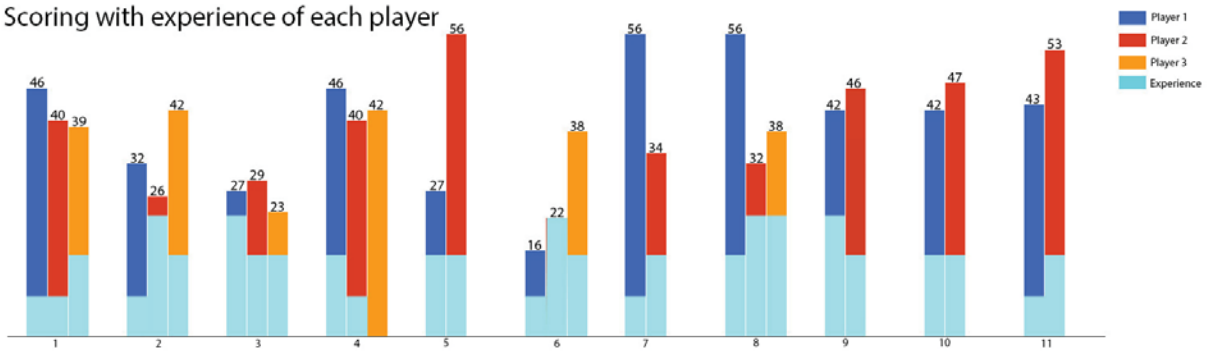

illustration 27 - Investigation 1.0 - Chart showing the experience level for each participant compared to score

Looking at the score compared to experince can show the learnability of a game. This was looked into by Gobet, et. al.(2004). They found that players with previous experience have steeper learning curves that inexperienced players.

When looking at the different scores participants gained, compared to how often they play tabletop games, there seems to be no direct correlation between the two. If anything it shows in the opposite direction as in session 2, where participant 5 have more experience that the winner of the match.

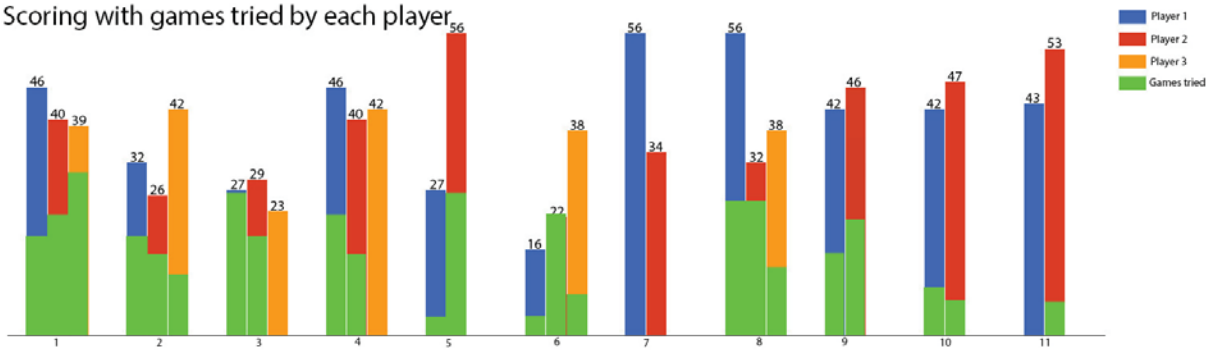

illustration 28 - Investigation 1.0 - Chart showing the amount of games tried for each participant compared to score

The score of participants compared to how many different games they have tried from the list in the questionnaire, seems to have no correlation with the score, as the illustration above illustration 27. The amount of games tried, depicted in the illustration, is not using the same scale as the score, though, they are comparable in scale to each other. There is one session with a great difference in amount of games tried, where the winner had tried more games previously than the other participant. The problem is that it is session 5, where the participant won by breaking the rules.

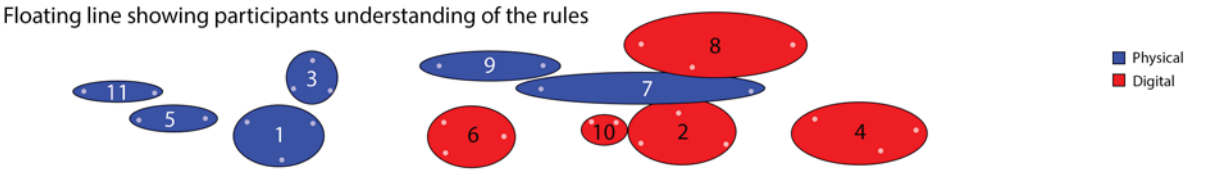

illustration 29 - Investigation 1.0 - Chart showing each participants level of understanding the rules

This chart is build up as a continuum chart describing how much each participant have understood the rules of 'Kingdom Builder'. The far left of the chart is defined as the participant having no understanding of the rules, where the far right defines the participant to have a full understanding of the rules. A circle is drawn around the participants of each session and they are differentiated between digital and physical sessions by the red and blue colour. Red being digital and blue being physical. The height of each circle describes how many participants were in the session. A small height indicates only two participants attended the session, and taller circles indicate three participants. The small dots in the circles defines where each individual participant is placed on the chart. There are no relevance in the vertical position the circles. They are placed in that way in order to the chart being easier to read.

From looking at this chart, it is clear to see that participants of the digital sessions had a greater understanding of the rules of 'Kingdom Builder', than the average participant of the physical sessions. Although there is still a great split between the participants that had the best understanding, compared to the ones with the worst. The greater understanding in the digital sessions is believed to be caused by the digital game helping the player comply to the rules. This is clearly seen in the videos, where participants are getting a better understanding of how the rules function during the first few rounds, by looking at what the game allows them to perform. Participants of the digital session might have problems memorizing the rules of 'Kingdom Builder' and not being able to project this onto the physical tabletop game. While participants of the physical sessions will have no problem transferring their knowledge onto the digital version.

illustration 30 - Investigation 2.0 - Chart showing each participants level of understanding the rules

The participants understanding of the rules was around the same amount, as the best physical sessions in the previous investigation. This can either be because of the higher experience level of the participants or due to the tutorial.

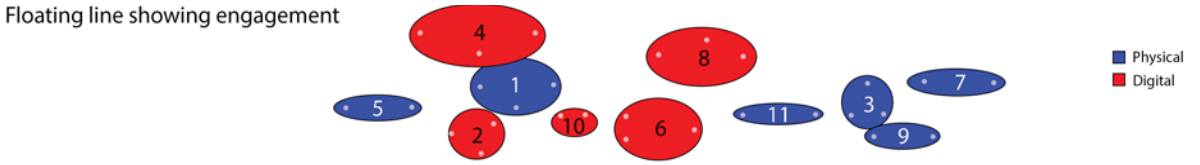

illustration 31 - Investigation 1.0 - Chart showing each participants level of engagement

This chart works the same way as the previous continuum chart, showing the level of understanding the participants had of the rules. Instead this shows the level of engagement for each participant within the session. There is a smaller gap between the participants in each session, as the more engaged participants would, in a way, force the participants who were more quiet, to talk with them. When looking at the chart compared to the other, where the digital session had a better understanding, now it is the physical sessions that have better engagement. Even during session 4, participant 12 expressed how there had been no direct contact between participant 12 and participant 10, that had been competing to take control of an area on the gameboard. Here it was expressed that whenever they would direct comments at each other, they would never look at each other, but instead look down at the tablet and say what they wanted, while pointing at the tablet. That shows that participants can still be engaged with each other while playing the digital version of 'Kingdom Builder', but there is still a medium between the participants. In the physical version there are still a medium between the participants, but here the medium are more comprehensible, as it is physical objects that can be picked up and manipulated, compared to everything happening behind a pane of glass in a digital reality.

There is also a big difference in the way participants engage with the learning medium (manual or tutorial) during the learning phase. In the physical version there are generally more communication between the participants and this communication transfers over in the gameplay phase. Here they are more keen to help each other, know the rules better, or try to optimize the other participants positioning of Settlements to gain a good score. While in the digital sessions participants tried to hide information about the rules, and in the game they only helped each other to understand the functions of the app, so that rounds could proceed faster to let them play again.

illustration 32 - Investigation 2.0 - Chart showing each participants level of engagement

The participants showed great engagement as in the previous physical sessions the reasoning behind session two, being lower than the first one, is the fact that they did the tutorial seperately, but after the tutorial they came back strong and helped each other greatly.

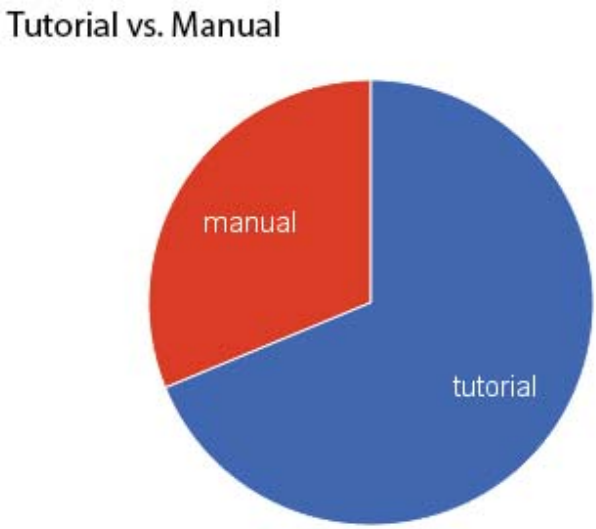

Illustration 33 - Chart showing procentage of people that want each different teaching method

When looking at participants' answers to the questions asked, at the end of the sessions, it can be said that most of the participants would prefer learning the game through a tutorial, instead of reading a manual. Some of the participants that wanted a manual was in the digital sessions. There were complaints about the quality of the tutorial from many participants. They thought that there were too much text, and not enough interaction. This might be the reason behind them choosing the manual over the tutorial. Also some participants, of the digital sessions, wanted to be able to look up all the rules while playing, which was not possible, as all the rules were in the tutorial and not available during gameplay.

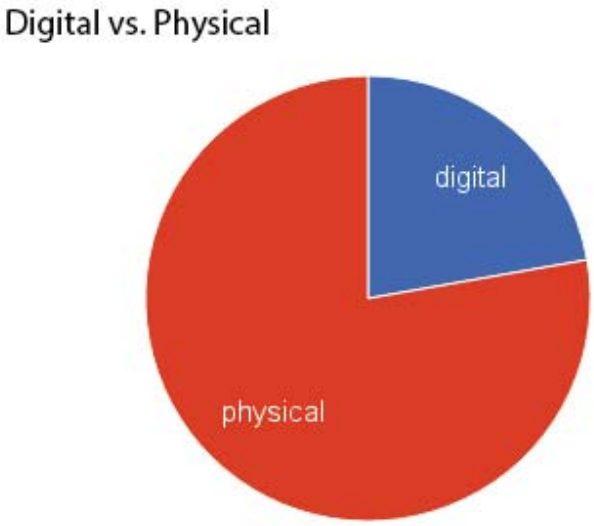

Illustration 34 - Chart showing procentage of people that want each different version

Contradicting themselves, most participants would rather play the physical version, rather than the digital version. This is both because they did not think the digital versions was social enough, and they lost contact with the other participants, from when they pressed play, till the scoring was done. They also thought the digital version were missing the tactile feel of the pieces, being placed on the board.

8.1. Bridges

Illustration 35 - A bridge on the kingdom builder board

A curious thing happened during the different play sessions, when participants were playing the physical version of 'Kingdom Builder'. They all had questions about the function of the bridges around the map. Most groups looked up bridges in the rule book, but found nothing. They would then discuss what function it should have. To clarify, the bridges have no other function but to give the gameboard a more artistic feel, and have no game mechanical function. Many groups defined the rules for the bridges, as they would connect Settlements across the river, and would help players getting points from the 'Merchant Kingdom Builder Card'. The even more curious thing is that no participants from a digital session mentioned the bridges at all. This is most likely due to the digital version of 'Kingdom Builder' highlighting all possible placements of Settlements, and therefore removing the need to talk about such rules.

During the Investigation 2.0 participants did not discuss the usage of the bridges during the learning or gameplay session. After the gameplay session during the interview there were questions concerning their thought about the bridges on the gameboard. All participants acknowledged that they had thought about what use the bridges had, and most thought that they had a function, but chose not to use them as that did not fit in their strategy. One of the participants saw it as just as a cosmetic feature on the gameboard to make a uninteresting river more interesting. The participants that thought the bridge had a function thought they would function due to balance, as some rivers block the connection of Castles and 'Location Hexes' and since they were playing with the 'Merchant Kingdom Builder Card', that give the player gold for every location tile and/or castle connected by settlements. They could not see how players would be able to gain points from the specific locations when a river was blocking the way. Some also thought that the bridges was a big contrast on the board and was easily seen, and therefore they must have a function. One participants thought that the bridges was part of an expansion to the game, and that was why bridges was not mentioned in the tutorial.

8.2. Kingdom builder cards

Illustration 36 - The digital version of 'Kingdom Builder'

The physical version had the problem with bridges, but in the digital version participants had a problem with not reading the 'Kingdom Builder Cards'. The tutorial use three specific 'Kingdom Builder Cards' that are different from the three 'Kingdom Builder Cards' selected for the sessions. In the gameplay session most participants would not notice that the three 'Kingdom Builder Cards' was different from the once used during the tutorial. They would play as if they were still using the 'Kingdom Builder Cards' from the tutorial. Most participants would realize this after a few turns and then read the cards, this would halt the amount of points gained by all participants. The main reason behind this could be that in the physical version, the 'Kingdom Builder Cards' are a physical card which needs to be placed beside the board. By doing this participants automatically read the cards. In the digital version it is only three small words in the top of the screen and therefore will be harder to notice.

The following table will both give an overview and summarize the many focus points in the data analysis and the theories used. This will function as a stepping stone to the discussion.

Area of interest	**Source**	**Conclusion**
Length of session (learnability, memorability)	Efficiency (Natoli 2014) & Houser & DeLoach (1996, 1998)	Digital have a more stable learnability, digital have better memorability
Gaming experience (learnability)	Gobet, Retschitzki, & Voogt (2004)	Participants with more previous experience have a steeper learning curve
Rules Discussed (learnability)	Effectiveness (Natoli 2014), Houser & DeLoach (1996, 1998), Thiagarajan (1993)	Digital have higher learnability. Tutorial need higher quality to merit further investigation.
Looking up rules (memorability)	Efficiency (Natoli 2014)	Digital have higher memorability
Looking up rules also available in digital version (engagement)		Digital create an anti social environment
Number of illegal moves (memorability)	Errors (Natoli 2014)	Digital have higher memorability
Number of different illegal moves (memorability)	Errors (Natoli 2014)	Some errors in physical is due to bad learnability
Score		Show that by higher understanding give a higher score
Scoring with experience of each participant (learnability)	Gobet, Retschitzki, & Voogt (2004)	There is no correlation between the two
Scoring with games tries by each participant (learnability)	Gobet, Retschitzki, & Voogt (2004)	There is no correlation between the two
Participants understanding of the rules (learnability)		Digital have a higher learnability
Participants engagement (engagement)	Prensky (2001a, 2001b, 2003), Thiagarajan (1993), Csikszentmihalyi (1997)	Physical have participants more engaged
Tutorial vs. manual	Prensky (2001a, 2001b, 2003), Jenkins (2002), Andersen et al. (2012)	Most participants wants to learn through a tutorial
Digital vs. physical	Prensky (2001a, 2001b, 2003), Jenkins (2002), Andersen et al. (2012)	Most participants wants to play physical

9. Discussion

Although this is only a small case study, there are still some tendencies that can be found from the data gathered for this study. It might not be a general theory but it can shine a light on what could be interesting for further study. In the data analysis many focus points were addressed and related to the included theories, which put a focus on how there are differences in learnability and memorability, and the users engagement with the game.
In the following, the point of departure will regard some of the issues, which respectively turned up in the physical and the digital version of 'Kingdom Builder'. In other words, the weakness and strengths of the respective versions. To assist in this discussion, ideas of a solution between a manual and a tutorial, will be essential. This will, in turn, assist to answer the problem statement (see 3. Problem statement).

Most participants of both investigation 1.0 and 2.0 said that they would rather play the physical version of 'Kingdom Builder', but would rather learn the rules from a digital tutorial. It was also found that participants had a higher level of engagement in the physical version, rather than the digital version. This is also confirmed by Prensky (2001a, 2001b, 2003) who talked about how users have increased engagement with digital game-based learning.
By looking at the data from the perspective of Joe Natoli (2014), there is a greater effectiveness in the digital tutorial looking at learning, due to the fact that participants both looked up and discussed fewer rules, than in the physical test sessions. The efficiency of learning in both products (digital and physical version of 'Kingdom Builder') are close to the same, when excluding the two big outliers in the physical version. Here the consistency of the digital version breaks through the efficiency over the physical version. Also during the gameplay sessions the digital version had a much higher efficiency. The satisfaction might be where the digital version falls a bit short. Every participant says that they would play the game again. Although many said that they would rather play the physical version, since they thought they would feel much more satisfaction, even though they would have to invest more time into learning the game.
Natoli's term of Errors is where the digital version excels, compared to the physical version. There were nearly no errors/illegal moves in the digital version and when the participants tried to make an illegal move, the tablet would not allow them to do this. They would instantly know that this was an error and never try it again. Whereas in the physical version multiple errors were made several times by different participants, and the errors were almost never corrected, either by the participant themself, or by the other participants, during the test sessions.
To summarize, the digital version have a better learnability and memorability, but the physical version have higher engagements. Therefore the further discussion will consist of a digital tutorial for a physical tabletop game. Possible solutions will now be presented and reflected upon.

On the basis of the data analysis and from Prensky (2001a, 2001b, 2003), it would show great progress if 'Queen Games' would include the digital version of 'Kingdom Builder', in every physical copy of the game. This would make it possible for people to be able to use the tutorial instead of reading the manual. Some participants argued, that they would rather install the digital version and play through the tutorial, before playing the physical game, than read the manual. The problem with first playing the digital tutorial, instead of reading the manual, is because the tutorial does not explain all the rules, through a single playthrough. It can be seen in the data from investigation 2.0. Here the two groups of participants was not able to understand some of the rules of the game, and had to discuss how they would transfer the rule shown in the digital tutorial to the physical game. As an example, this is shown in the digital game, the participant automatically gain a new 'Terrain Card' each turn, and in the physical version, the player had to discard the 'Terrain Card' played during his/her turn, and draw a new card. This is also the reason behind only having two sessions of investigation 2.0, as the tutorial needs improvement to merit further study. This can also be drawn to the way Prensky (2001a, 2001b, 2003), Jenkins (2002), and Thiagarajan (1993) view how digital tutorials can

have increased engagement for the player. From Jenkin's (2002) perspective the tutorial for 'Kingdom Builder' hits the same problem that he finds in other instances, where the quality is subpar to the physical counterpart. Another argument for having the digital copy of 'Kingdom Builder' included in the physical copy is, that the data shows increased learnability in the digital copy. This would increase the satisfaction factor, defined by Natoli (2014), of the game in total.
It is common practice between the participants, that they have a single friend buy a game and then meet up to play the game together. The owner would, with a digital version, be able to play through a few games on the tablet, before meeting up with their friends to play the game. This would save a lot of time for everyone, when someone would already know the rules and then being able to explain it to the other players. It was also mentioned by some of the participants as some of them had never read a game manual. They always played tabletop games with people that already knew the rules. Other people would watch a video of how the game should be played on a platform such as youtube. The problem with watching a video is that you are not able to interact with the game. Notably this is also the teaching method, expert observation, as described by Gobet and colleagues (2004). By having the tutorial teach you a game mechanics and then having you use the mechanics, this helps you remember the rules, as defined by Thiagarajan (1993).

Houser and DeLoach (1996, 1998) describe, that tabletop games can gain improved learnability by utilizing the same teaching methods used in video games. Some tabletop games try to have physical tutorials in their manual. An example of this could therefore be predefined scenarios, where players try out the mechanics of the game in a safe scenario. This can be seen in games like 'Warhammer Quest: the Adventure Card Game'. Here the publisher have made a tutorial setup, that is supposed to teach the player the basic game mechanics, but still keep some mechanics hidden, until later in the manual since they only have a small impact in the game. The rules are better shown after players understand the basis of how the game is played. This is also discussed by Thiagarajan (1993) when he talks about how users should first be introduced to the basic mechanics and gain an understanding of them, before introducing the more complex rules.
The same happens in a game called Zombicide. This is a scenario based zombie survival game. After the players have read the rules they have to play a scenario, where players are forced to use what they have learned, in order to get through the scenario. This includes searching for weapons, to break through a locked door, and to kill zombies blocking the way to the exit of the level. The tutorial scenario only takes about 10 minutes, but it still manages to show the player, how to use the different rules, the players just previously read in the manual. This is another alternative to digital tutorials. Although the problem with this is that many games include many random elements, where the rules can differ a lot, depending on how the game had evolved from the beginning.This way of having physical tutorials works great with scenario based games like Zombicide or 'Warhammer Quest: the Adventure Card Game', since they can force players into using mechanics learned, in order to proceed in the game.
On the other hand if it was used in a game like Carcassonne, where players have to flip over tiles, then the manual would have to show where it should be placed. This seems to be too much for most players to go through. Whereas in the digital tutorial for Carcassonne, the game have already specified what tiles will be turned over, and it will show players where they could place it. For the sake of the tutorial they would point out a specific placement of the tile, and then go on to showing how Meeples (similar to Settlements from 'Kingdom Builder') are placed on the tiles already in play. Then it would show how scoring of the Meeples happen for each different type of tile. The same would apply to 'Kingdom Builder', where a physical tutorial would only increase the cognitive load, and in turn reduce the learnability of the game as described by Natoli (2014).

It is very interesting to see how previous tabletop gaming experience affect the amount of time it takes, for participants to read the manual, for the physical copy of the game. While in the digital tutorial for the game, there is almost no difference in the amount of time it takes to play through the tutorial. This shows that if participants had already played many different games, it will be easier for them to read the manual and understand it, as they already know many of the terms, that are used in these technical writings for tabletop games. While on the other hand in the digital tutorial, participants does not need to have any previous tabletop experience. This is the same that was found by Gobet and colleagues (2004) when looking at the difference between self taught and school taught teaching methods.
After telling the participants what rule they will now discover, the tablet shows how it functions and this reduces the risk of confusion about what different terms mean. This could also be seen from the videos where participants in the digital session would not have many discussions during the tutorial other than the last step in the tutorial, where discussions are encouraged if more participants share the tutorial. Instead when reading the manual, if participants came upon terms they did not understand, they would have to stop learning the game and have to discuss the meaning of the term. Mainly there where a participant in the group that knew what the term meant, otherwise, they would have to figure it out on their own by reading on and maybe getting the meaning of the term from the context.

Prensky (2001a, 2001b, 2003) talks about the fact that participants from the 'Games Generation' would always be motivated by game-based learning methods. This was not the case with many of the participants in the digital sessions. In the end of the tutorial it would automatically jump to the last turn of the game and have the participants try and optimise the amount of points achieved by using the optional actions from four different 'Location Tiles'. During some of the sessions the participants would choose to skip this part so that they would be able to begin the real game faster, even though there were some important lessons to be learned from discussing how to optimize the points.

The different types of rules that participants struggled with can be placed in the three categories that Salen and Zimmerman (2004) presented in their book 'Rules of Play'. More than half of the participants in the physical sessions found problems understanding the Constitutive rules, which is the foundation of the game. Players found more ease in understanding the Operational rules. It turned out that rounds would quickly get to a fair speed, where participants would not hold the game up, by trying to understand the different phases of a turn. Only very few participants started using the implicit rules of the game, in the sense of trying to interfere with other participants, or strategize how to optimize their total score. This can be seen in the participants of session 7 and 8, they found strategies that would increase their score greatly. It can be argued that because they used the implicit rules they have a greater understanding of the rules than other participants.

Andersen et al. (2012) found, that if participants could be able to understand the game mechanics of a video game, without the help of a tutorial, only through exploration, then it would reduce the engagement of the participants. My study finds the opposite, when looking at the answers given by some of the participants in the digital version, they would have wanted a more expansive and more interactive tutorial for 'Kingdom Builder' even though, there is not much complexity in the game mechanics, but in the strategy. The strategic elements can only be found through exploration.

10. Conclusion

The problem statement ask if there is a difference in the learnability and memorability of the physical and digital version of ‘Kingdom Builder’. From the data backed up the literature, it has been found that the digital version have a higher learnability and memorability than the physical version. The digital tutorial have a better ease of access where people of all skill levels can open it up, and quickly learn the rules of the game. In the physical manual there is a higher skill level required to understand how to translate the manual to actions on the board.

The problem statement also ask what version of ‘Kingdom Builder’ is more engaging. It was found that the physical version had participants more engaged. This can also be seen by the fact that, some participants of the digital sessions, would during the interview answer that they would rather have played the physical game instead of the digital game. As they thought they would be more engaged in the physical version.

Through the discussion it was concluded that ‘Kingdom Builder’ would be an enriched experience, if the digital tutorial was included in the physical game box. This would give more people the ability to have the increased learnability from the tutorial.

11. Future work

Another way for testing the Learnability of 'Kingdom Builder' could be using the same technique as Stickel and colleagues from their 2007 article "Enhancing Universal Access – EEG Based Learnability Assessment" Stickel et. al. (2007), they found an interesting way of assessing the learnability of products using a low-cost EEG (Electroencephalography). By having participants play a digital version of a memory game with four pairs. The control consisted of eight games with the pairs having random placements, in the second test session the placement of pairs would be consistent just the pairs swapping placement. By looking at the participant's Alpha and Beta brain waves from the frontal lobe they could conclude that after game six the average good participant would figure out that the placement was the same for pairs in the second test session. This could be a way of looking at the learnability of Kingdom builder. Stickel and colleagues (2007) research method for testing when participants went from a phase of trying to understand a phenomenon to having a complete understanding that also could have been used during this study. By using a low-cost EEG on every participant the alpha and beta waves could be measured to find when the participant did go from the phase of learning the game to finding strategies. This would help give a more precise metric to measure the learnability. This method was not chosen because of the lack of experience with EEG and analysing the data from them.

It would be interesting having all participants come in again to play a new game of 'Kingdom Builder' using the same game board and 'Kingdom Builder Cards'. This time on the opposite copy that they tried last time ergo having the participants from the physical test sessions play the digital version and vice versa. Here the point would be to look at how each participant would remember the rules of the game and how much they needed to look up again. If the participants from the physical version had to stop playing, to play through the tutorial. If the participants from the digital test sessions had to read through the manual, and also if doing so would give them some insight into how the game worked. Here the question about whether or not the digital version made participants understand the rules also made them better at memorizing the rules or if the players of the physical version have a better memory of the rules as it had become muscle memory.

To ensure that this result is not only achievable by having participants play 'Kingdom Builder' more tabletop games will have to be played. Studying more tabletop games will help to show, if it is a general theme within tabletop games, that a digital tutorial could help in the learnability of the game. Here it will be important to both test on similar simple tabletop games, but also on the bigger and more complex games, as there is a very big difference in both learning curve and complexity, in different tabletop games. Games such as 'Twilight Imperium' and 'Blood Rage' have many more rules and conditions that change the rules, than games like 'Kingdom Builder' or 'Settlers of Catan'. There is also the problem of knowing the different levels of engagement between these games since there can be a clear difference. Here the theory of Gameflow (Sweetser et al., 2005) could be used to help differentiate them and help to show why one tabletop game might show more promise than the other. Gameflow builds on eight different elements that each have a subset of criteria. Each criteria will be scored from zero to five depending on how well the criteria is meet. The different elements of Gameflow are:

1. **Concentration**: The game have to require concentration to play, and the player should be able to concentrate on the game and not get distracted.
2. **Challenge**: The game must be challenging in a way that match the player's skill level.
3. **Player skills**: The game should support the player in developing his skills and in the end mastering them.
4. **Control**: The player needs to feel in control of the game and not have actions happen against his wishes.
5. **Clear Goals**: The game must have a clear end with even clearer milestones.
6. **Feedback**: The game must provide the player with the correct feedback when appropriate.
7. **Immersion**: The game should pull the player into the experience without the player spending much effort for this to happen.
8. **Social interaction**: The game must support opportunities for players to have social interactions within or outside of the game.

For further study into the subject of digital tutorial versus having a manual, showing all parts, it would be interesting to study other fields such as video games or even software such as 'Microsoft Excel' or 'Autodesk 3DS Max'. I see especially an interest in looking at video games. Here the video game industry have mainly dropped the traditional manual that followed with every game, telling the player how to play the game. Nowadays only few video games even come with a manual to teach the player about the game. They have all transitioned away from having manuals, and instead turned to tutorials. Here they have two different ways of doing tutorials. The standalone tutorial and the ingame tutorial. In the standalone tutorial, there are no connection between the game and the tutorial. Here the player does not lose any context of the game if the tutorial is skipped. This will mainly be seen in strategy games, where many players have already played a great number of different strategy games, and for them it makes no sense playing through a tutorial, to know how to select and move figures around the map.
The ingame tutorial is now the most common way in the industry for adding tutorials in a game. Here the tutorial is instead hidden from the player disguised as levels in the game. This can, as an example, be seen in many first person shooters like 'Call of Duty' where the player is asked to go through a training course to show the character's skills in combat. There are also video games that expand the tutorial part of the game to the first few hours of gameplay. Here elements are slowly added, when players have learned the skills from previous tutorials. This can be seen in a game like 'Middle-earth: Shadow of Mordor', where the player is first taught about the way the character can fight in the game. After teaching the basics, the game transitions to a section where stealth is a factor, but also includes parts of combat again. Even later, about 4-5 hours in, the game leads the player into new sets of tutorials teaching the player to ride beasts, and take control over enemies.

It would be interesting to see if these ways of doing tutorials could be used in the same way with more complex tabletop games, where some features is not applied before later in the game. This could be used in games like 'Blood Rage' which is a game about vikings that fight over who controls the nine realms. It is divided into three different ages where more features are added in each age. Here the tutorial could start by teaching the players the basics and then at the beginning of each age could teach the players what new elements are added to that age.

A difficulty can be found studying the use of tutorials in other software, could be finding software that already have a tutorial built in. This is often due to most software having so many functions that a user would only need to use about 10% of all the functionality. This means that developers will have to divide all tutorials into groups of what function they have and users will still have to do parts of the tutorial that they will never use. There will be many problems with looking into this subject. But I think some software would see a great improvement in usability by having this feature. Software such as 'Autodesk 3DS Max' could use tutorials to teach the user the basic functionality of the software and how they can be used together.

11 References

Andersen, E., O'Rourke, E., Liu, Y.-E., Snider, R., Lowdermilk, J., Truong, D., … Popovic, Z. (2012). The Impact of Tutorials on Games of Varying Complexity. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 59–68). New York, NY, USA: ACM. https://doi.org/10.1145/2207676.2207687

Beasley, N. (2004). A study of adult engagement with constructivist computer games. Unpublished Doctoral Thesis, Napier University, Edinburgh. Retrieved November, 8, 65.

Benford, S., Magerkurth, C., & Ljungstrand, P. (2005). Bridging the physical and digital in pervasive gaming. Communications of the ACM, 48(3), 54–57.

Blumer, A., Ehrenfeucht, A., Haussler, D., & Warmuth, M. K. (1989). Learnability and the Vapnik-Chervonenkis dimension. Journal of the ACM (JACM), 36(4), 929–965.

Brinkmann, S., & Tanggaard, L. (2010). Kvalitative metoder: en grundbog. Hans Reitzels Forlag.

Crammer, K., & Singer, Y. (2002). On the learnability and design of output codes for multiclass problems. Machine Learning, 47(2–3), 201–233.

Csikszentmihalyi, M. (1997). Finding flow: The psychology of engagement with everyday life. Basic Books. Retrieved from https://www.google.com/books?hl=en&lr=&id=HBod-fUzmBcC&oi=fnd&pg=PP11&dq=Csikszentmihalyi&ots=V_aq4IDSXE&sig=titl5gEdsYUBEz1ohCmrgVtKtnM

Geek & Sundry. (2015). Kingdom Builder | Paul Scheer, Tara Platt & Yuri Lowenthal join Wil Wheaton on TableTop! Retrieved from https://www.youtube.com/watch?v=g9X2x-OENB0

Gobet, F., Retschitzki, J., & Voogt, A. de. (2004). Moves in Mind: The Psychology of Board Games. Psychology Press.

Houser, R., & DeLoach, S. (1996). Instructional design lessons technical communicators can learn from games. In Professional Communication Conference, 1996. IPCC'96 Proceedings. Communication on the Fast Track., International (pp. 269–277). IEEE. Retrieved from http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=552607

Houser, R., & DeLoach, S. (1998). Learning from games: Seven principles of effective design. Technical Communication, 45(3), 319–330.

Jenkins, H. (2002). A Game Theory On How To Teach Kids. MIT Technology Review, 4.

Linial, N., Mansour, Y., & Nisan, N. (1993). Constant depth circuits, Fourier transform, and learnability. Journal of the ACM (JACM), 40(3), 607–620.

Magerkurth, C., Cheok, A. D., Mandryk, R. L., & Nilsen, T. (2005). Pervasive games: bringing computer entertainment back to the real world. Computers in Entertainment (CIE), 3(3), 4–4.

Magerkurth, C., Memisoglu, M., Engelke, T., & Streitz, N. (2004). Towards the next generation of tabletop gaming experiences. In Proceedings of Graphics interface 2004 (pp. 73–80). Canadian Human-Computer Communications Society. Retrieved from http://dl.acm.org/citation.cfm?id=1006068

Magerkurth, C., Stenzel, R., & Prante, T. (2003). Stars-a ubiquitous computing platform for computer augmented tabletop games. Proceedings of Video Track of Ubiquitous Computing (UBICOMP'03). Retrieved from https://www.researchgate.net/profile/Carsten_Magerkurth/publication/228825201_STARS-a_ubiquitous_computing_platform_for_computer_augmented_tabletop_games/links/0046352e230328c201000000.pdf

Natoli, J. (2014, July 15). Learnability: 5 Principles of Interaction Design To Supercharge Your UI (3 of 5). Retrieved January 4, 2016, from http://www.givegoodux.com/learnability-5-principles-interaction-design-supercharge-ui-3-5/

Parlett, D. S. (1999). The Oxford History of Board Games. Oxford University Press.

Piccione, P. A. (1980). In search of the meaning of Senet. Archaeological Institute of America. Retrieved from http://www.sankofaarchives.com/pdfs/%E2%80%9CIn%20Search%20of%20the%20Meaning%20of%20Senet,%E2%80%9D%20by%20Peter%20A.%20Piccione.pdf

Prensky, M. (2001a). Fun, play and games: What makes games engaging. Digital Game-Based Learning, 11–16.

Prensky, M. (2001b). True believers: Digital game-based learning in the military. Digital Game-Based Learning.

Prensky, M. (2003). Digital Game-based Learning. Comput. Entertain., 1(1), 21–21. https://doi.org/10.1145/950566.950596

Rogers, Y., Sharp, H., & Preece, J. (2011). Interaction design: beyond human-computer interaction (3rd ed). Chichester, West Sussex, U.K: Wiley.

Salen, K., & Zimmerman, E. (2004). Rules of play: Game design fundamentals. MIT press. Retrieved from https://www.google.com/books?hl=en&lr=&id=UM-xyczrZuQC&oi=fnd&pg=PP13&dq=rules+of+play&ots=2AIFsW6FSu&sig=2t0EPf-gdT-CYX5Fdft4JFzs9DU

Sandelowski, M. (2000). Combining Qualitative and Quantitative Sampling, Data Collection, and Analysis Techniques in Mixed-Method Studies. Research in Nursing & Health, 23(3), 246–255. https://doi.org/10.1002/1098-240X(200006)23:3<246::AID-NUR9>3.0.CO;2-H

Schapire, R. E. (1990). The strength of weak learnability. Machine Learning, 5(2), 197–227.

Stickel, C., Fink, J., & Holzinger, A. (2007). Enhancing Universal Access – EEG Based Learnability Assessment. In C. Stephanidis (Ed.), Universal Access in Human-Computer Interaction. Applications and Services (pp. 813–822). Springer Berlin Heidelberg. Retrieved from http://link.springer.com.zorac.aub.aau.dk/chapter/10.1007/978-3-540-73283-9_88

Sweetser, P., & Wyeth, P. (2005). GameFlow: A Model for Evaluating Player Enjoyment in Games. Comput. Entertain., 3(3), 3–3. https://doi.org/10.1145/1077246.1077253

Thiagarajan, S. (1993). Simulation game design prescriptions from cognitive psychology. SIMULATION AND GAMING YEARBOOK, 1, 1–1.

Watson, B. (1992). The Tso chuan: selections from China's oldest narrative history. Columbia University Press.

11.1 Illustration references

Illustration 1. (n.d.). Retrieved April 11, 2016, from http://ecx.images-amazon.com/images/I/91q-br5KSuL._SL1500_.jpg

Illustration 2. (n.d.-a). Retrieved April 10, 2016, from http://my-culture-buzz.com/wp-content/uploads/2015/11/g0703090554011.jpg

Illustration 2. (n.d.-b). Retrieved April 10, 2016, from http://listverse.wpengine.netdna-cdn.com/wp-content/uploads/2013/01/Royal-Game-of-Ur.jpg

Illustration 2. (n.d.-c). Retrieved April 10, 2016, from https://s-media-cache-ak0.pinimg.com/736x/55/c1/9a/55c19ae3f7ef7473b8a4fec69aadff90.jpg

Illustration 2. (n.d.-d). Retrieved April 10, 2016, from http://hans.wyrdweb.eu/wp-content/uploads/2009/12/ancient-game-300x224.jpg

Illustration 3. (n.d.). Retrieved April 10, 2016, from http://i.ebayimg.com/00/s/NTY2WDg0OQ==/z/YKsAAOSwv0tVAVbV/$_32.JPG?set_id=880000500F

Illustration 4. (n.d.). Retrieved April 21, 2016, from https://s-media-cache-ak0.pinimg.com/736x/fb/b0/4b/fbb04bcc60fde8da8f6f66bd03ffa4ce.jpg

Illustration 5. (n.d.). Retrieved April 21, 2016, from http://www.gamehead.com/sites/default/files/styles/gh_article_banner_teaser/public/images/article/thumb_files/1498/agricola-7cfa7i2.jpg?itok=U_JZI9Cq

Illustration 6. (n.d.). Retrieved April 21, 2016, from http://ecx.images-amazon.com/images/I/51unbwEje5L._SX300_.jpg

Illustration 7. (n.d.). Retrieved April 17, 2016, from https://images-na.ssl-images-amazon.com/images/G/15/aplusautomation/vendorimages/fbbc5afe-20e5-41fe-a986-be142bed9cf5.jpg._CB301332076__SR970,300_.jpg

Illustration 8. (n.d.). Retrieved May 26, 2016, from http://ecx.images-amazon.com/images/I/81URy80x2tL._SL1417_.jpg

Illustration 35. (n.d.). Retrieved April 22, 2016, from http://blog.metagames.co.uk/wp-content/uploads/Kingdom-Builder-close-up.jpg

Illustration 36. (n.d.). Retrieved May 3, 2016, from http://a2.mzstatic.com/us/r30/Purple4/v4/8f/9f/35/8f9f35e4-a4cd-1ab0-67c8-dd3f1d816529/screen480x480.jpeg