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‘On the move’: Investigating engagement related to mobile video learning.

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Declaration

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Abstract

The focus of this research is in the area of mobile video learning. As smartphone usage continues to grow so does its impact on how we manage our day-to-day lives. This presents users with great opportunities to access learning materials 'on the move', at any place and at any time. Mobile video learning is a topic that is becoming increasingly popular. Many teachers are beginning to realise its potential but despite this, there is little knowledge on what makes for an engaging mobile video experience.

The aim of this research is to identify what characteristics make mobile video lessons engaging to users. Such a study is important in order to assist teachers in creating valuable content. This dissertation explores how different characteristics of mobile video such as duration and presentation style, can affect users' engagement levels and ability to learn. The research method used consisted of a wide review of relevant literature and an experimental study. The findings from this research show that video duration has a significant effect on users' engagement levels and that a new framework can be used to measure users' engagement in relation to mobile video learning.

Keywords: Mobile, Video, Learning, Engagement, Immersion.

Table of Contents

1. Introduction **7**
1.1 Objectives 8

2. Literature Review **10**
2.1 Introduction 11
2.2 Video Learning and Mobile 11
2.2.1 Defining Mobile and Mobile 'Video' Learning 10
2.2.2 Impact of Mobile Video Learning 13
2.2.3 Characteristics of Mobile Video Learning to Consider 15
2.3 Engagement and Learning 17
2.3.1 Defining Engagement Related to Learning 17
2.3.2 Concept of Immersion and Learning 18
2.3.3 Factors that Affect Immersion 20
2.4 Emerging Issues and Need for Empirical Research 21

3. Research Methods **22**
3.1 Research Overview 22
3.1.1 Experiment Design Overview 23
3.1.2 Reducing Experimental Bias 24
3.1.3 Data Collection and Analysis 26
3.2 Hypothesis 26
3.3 Research Measures 27
3.3.1 Independent Variables 30
3.3.2 Dependent Variables 31
3.3.3 Qualitative Data 31
3.4 Data Collection 31
3.4.1 Background Questionnaire 31
3.4.2 Immersion Experience Questionnaire (IEQ) 32
3.4.3 Single Immersion Question (SIQ) 34
3.4.4 Post-Lesson Exam 35
3.4.5 Semi-Structured Interview 36
3.5 Participant Recruitment 37
3.6 Design and Development of Video Lessons 40
3.6.1 Lesson Styles and Duration 40
3.6.2 Subject Matter 40
3.6.3 Instructor 41
3.7 Framework For Data Analysis 41
3.7.1 Quantitative Analysis 41
3.7.2 Qualitative Analysis 42
3.8 Experimental Procedure 42
3.8.1 Experimental Setting 46
3.8.2 Equipment 46
3.8.3 App Prototype 47
3.8.4 Session Scripts and Materials 48

3.8.5 Ethics 49
3.9 Lessons Learned from Pilot Session 49
3.10 Limitations and Potential Problems 50

4. Results and Discussion **52**
4.1 Introduction 52
4.2 Investigating Video Characteristics and Immersion 52
4.2.1 Immersion Experience Questionnaire (IEQ) 52
4.2.2 Participants IEQ Findings 52
4.2.3 A 2nd Measure of Immersion: Single Immersion Question (SIQ) 56
4.2.4 Participants SIQ Findings 56
4.2.5 SIQ and IEQ Visual Analysis 59
4.2.6 Relationship between SIQ and IEQ 61
4.2.7 Analysis of Difference for Six Conditions 64
4.2.8 Interaction Effects Between Video Length and Style 64
4.2.9 Video Length and Immersion 65
4.2.10 Impact of Presentation Style on Immersion 66
4.2.11 Discussion 66
4.3 Immersion Factor Findings 68
4.3.1 Cognitive Involvement 68
4.3.2 Real Word Dissociation 70
4.3.3 Emotional Involvement 72
4.3.4 Challenge 74
4.3.5 Control 76
4.3.6 Discussion 78
4.4 Exploring the Effect of Immersion on Learning 78
4.4.1 Post-Lesson Examination 78
4.4.2 Participants Exam Findings 78
4.4.3 Relationship between Learning and Immersion 82
4.4.4 Analysis of Difference for Six Conditions 88
4.4.5 Interaction Effects between Video Length and Style 88
4.4.6 Impact of Video Length on Participant Scores 88
4.4.7 Impact of Presentation Style on Participant Scores 88
4.4.8 Discussion 90
4.5 Overall Discussion 90

5. Evaluation, Reflection and Conclusion **91**
5.1 Project Planning 91
5.2 Literature Review 91
5.3 Method 92
5.3.1 The Video Lessons 92
5.3.2 Participant Recruitment 92
5.3.3 Experiment Procedure 92
5.4 Data Collection & Analysis 93
5.5 Summary of Findings 95
5.6 Self Reflection 95
5.7 Further Research 95

5.8 Conclusion 96

6. References **97**

7. Appendices

A. Project Proposal
B. Study Plan
C. Video Lesson Screenshots
D. App Screenshot
E. Call for Participation
F. Screener
G. Participant Information Sheet
H. Informed Consent Form
I. Experimenter Script
J. Background Questionnaires
K. Post-Lesson Exam Template
L. Immersion Experience Questionnaires (IQ)
M. Video Randomisation order
N. Lesson Scripts & Marking Scheme
O. Links to Video Lessons
P. Qualitative Data
Q. Quantitative Data (SPSS)

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1. Introduction

Worldwide mobile usage has grown at a phenomenal rate in recent years and is expected to continue to do so into the next decade. According to the International Telecommunications Union (2013), there were almost as many mobile-cellular subscriptions as there were people, with 6.8 billion subscriptions held by approximately 3.2 billion subscribers in 2013. As these figures continue to grow increasing numbers of users will move to smartphone technologies as they become more affordable, and mobile networks become more accessible. Smartphones and tablet devices have changed the way in which we socialise, manage our day-to-day lives, work, and learn. This influence is testament to the developments in mobile technologies such as the iPhone, iPad, Android and Windows based systems. This extraordinary growth in mobile users has presented great opportunities in the area of mobile learning otherwise known as m-learning.

Traditionally, teaching was confined to the classroom environment where the tutor was the central point of knowledge for student learning. In the past 20 years the dynamics of teaching has changed dramatically and advances in technologies have presented new opportunities. The Internet is now a focal point of pedagogical strategy that has changed how access learning. It has also changed the role of the tutor, who is now seen more as a facilitator or guide, rather than the central source of knowledge. Technology has also been integrated into the classroom environment, which provides a diverse learning experience for students. The explosion of e-learning sees benefits such as time and location flexibility; cost savings; self paced learning; and increased access to materials (Zhang et al, 2008: 17). Through the use of massive open online courses or MOOC's, students can now gain access to a huge repository of free content produced by the world's top lecturers from institutions such as Yale, Harvard and Stanford.

Mobile learning is often seen as an extension of e-learning. Handheld devices such as smartphones present great opportunities as they can be used to access learning materials and multimedia from any place at any time. This gives a great sense of control back to the user, where they can manage learning around their schedules. Evans (2008) asserts that as learners always have their mobile devices with them, this facilitates 'just-in-time' learning, where learners can take advantage of unexpected free time to study. Of course as technology advances mobile learning may not be confined to just handheld smartphones and tablets. In the future learning may also be delivered through wearable devices such as Google Glass.

Video multimedia is widely used in learning and when used appropriately it can be very powerful. This form of learning can be seen as more appealing to students when compared to textbooks or graphics. Videos can help students visualise how something works; explain difficult concepts through images; stimulate discussion; and cater for alternative learning styles (Maniar, 2008: 53). As smartphone operating systems can now handle large volumes of video content, and improvement to 3G and 4G networks enable content to be downloaded or streamed faster, mobile video learning is becoming a powerful teaching tool that is accessible. Many teachers are beginning to realise the potential of mobile learning, but despite the hype around the subject nobody has stopped to ask the question: what makes for an engaging mobile video lecture?

Due to the environmental context of mobile learning, it may be questionable if video e-learning materials can be replicated on mobile devices. The use of a smaller screen and video duration times are factors that may need consideration, as they may affect user behaviour. M-learning literature suggests that mobile video learning may be more effective if delivered in bite-sized format as mobile usage is designed for short, sharp interactions (Little 2008, Melhuish and Falloon 2010). As mobile learning is seen as 'just-in-time' learning anywhere and any point in time, students may need alternative forms of content from the same learning material to best serve their needs. Due to the hectic speed of life on the go, mobile video content may need to focus on just the essential information to be useful to viewer.

In this research the question on how one can obtain value from this new form of learning technology is explored. To date there has been little or no research conducted in this area. This study aims to provide a better understanding of video learning within the mobile space, and tries to identify ways in which one can improve a student's engagement, and therefore their learning experience. There is a lot more to mobile learning than just the incorporation of a new piece of technology into the current learning eco system. It requires a complete change in approach.

The timing of this research is fitting. In 2014 content providers Coursera, Udacity and Skillshare launched their mobile apps on IOS and Android. This is a new and exciting area. Also there has been little research conducted on the subject, which was a great appeal in choosing the topic for this study. The results could potentially contribute to the knowledge of this ubiquitous form of learning, and may inspire others to conduct further research.

1.1 Objectives

Since mobile video learning is becoming increasingly popular, the overall objective of this project is to indentify ways to improve mobile video content on smartphone devices. Specifically within the context of mobile learning this study aims to answer the following research questions:

- What characteristics of educational videos on smartphone devices make them more engaging to users?

- What is the effect of engagement on learning using smartphone devices?'

In order to understand what was needed to improve this teaching content, it was concluded that the best way to get insight into mobile video learning was to work directly with a user group. To facilitate this study research was conducted on relevant literature in this subject area in conjunction with the collection and analysis of empirical data through an experimental study. Although this is a study on mobile learning its purpose is not to explore different mobile environments or to record participant's usage in public spaces. The focus of the research is purely on the teaching content. The experimental study will be conducted in private settings with little distraction, where users can concentrate and feedback on content. The overall research hypothesis was:

As smartphone video characteristics such as length and presentation style change, so do users engagement levels and ability to learn.

A mobile video learning experience will be created to explore this.

The purpose of the study's first objective is to assess the impact that changes to video characteristics have on participant's levels of engagement. Although there are many characteristics that contribute to a mobile video, it is thought that the two most interesting and valuable are video presentation style and video duration.

Presentation style was chosen as the physical attributes of a smartphone device, such as the smaller screen size, may favour one presentation style over another. Also presentation styles such as whiteboard video animations are becoming more commonly used by teachers to deliver content. Although this new and exciting style is visually impressive, research has yet to be conducted to identify if users actually find this format more engaging than other presentation styles. This research wants to explore how whiteboard animation performs on smartphones, and how it fairs in comparison to the more traditional 'teacher to camera' presentation style.

The second characteristic chosen was video duration times. The reason it was considered that mobile is associated with swift interactions due to the mobility of users. For this reason it was thought that participants may have a preference to shorter video durations when using portable devices. Three different video lengths will be tested for each presentation style. Qualitative data will also be used to help explain why users perform the way they do.

Answering this first research objective will help inform teachers on what characteristics are important when creating mobile content. Participant opinions and measures of engagement will be recorded, which will help answer - what makes an engaging mobile video experience? Objective one will also put into action a new measure of learner engagement, which if successful can be used by researchers for similar studies in the future.

The second research question will be used to investigate if engagement has any effect on users' ability to learn using a smartphone. This has yet to be proven in the context of mobile video learning, therefore it is an important question to ask. It would be a mistake for the each of these objectives to be viewed separately. Both research questions are highly related. If it can be proven that engagement on smartphone devices is in fact related to learning, then theoretically changes to video characterises that effect engagement, should also impact learning performance. In answering this objective participants will be tested on the video lesson taken.

The results from this research will contribute to the development of mobile learning in a number of ways: firstly, by identifying issues related to m-learning, teachers creating content will be better prepared to avoid pitfalls that may disengage users; secondly, recommendations will be made for the creation of future content supported by participants' quantitative and qualitative data; thirdly,

the theory that engagement is related to participants' ability to learn on smartphones, will either be accepted or rejected; and finally a new way to measure learner engagement on mobile devices will be proposed.

The following chapter examines literature relevant to the goals of this study and highlights research opinion towards mobile learning and the potential impact mobile learning may have on the future. After this the methodology used for this research will be explained. This will include information on how empirical data was collected in the experimental study and then later analysed. Finally results will be evaluated using statistical tools. Conclusions from the study will be drawn and then recommendations will be made for future research. All materials related to this study such as the video lessons used, session recordings and participant responses, can be found on the accompanying USB stick.

2. Literature Review

2.1 Introduction

This literature review will explore the main issues surrounding video learning using mobile devices. It will focus on both research objectives identified in section 1.1 of our introduction:

1. What characteristics of educational videos on smartphone devices make them more engaging to users?
2. What is the effect of engagement on learning using smartphone devices?

The literature explored will help contribute to answering these questions and provide insight into creating engaging mobile video content. It will define what mobile learning is; assess what characteristics of mobile video learning are important; discuss the impact of engagement on learning; and highlight a new concept of immersion in relation to learning. Immersion will then be investigated in more detail to highlight individual immersive factors for consideration.

Finally empirical research will be identified that will help both teachers create future content and researchers measure engagement levels in future studies. The benefits of this literature will help provide a thorough understanding of mobile video learning, provide a clear focus for this empirical research, and help inform the reader of the fundamental factors to be considered.

First, the meaning of the terms 'mobile learning' and 'mobile video learning' will be discussed.

2.2 Video Learning and Mobile

2.2.1 Defining Mobile and Mobile Video Learning

The Consumer Tablet Forecast Update 2013-2017 has estimated that approximately 1 billion people across the world will own tablets by 2017 (up from 380 million in 2013) (Little 2013). As mobile devices are now more accessible than ever e-learning providers such as Coursera are beginning to enter the mobile learning space providing content to over 4 million student members. According to Carson Kahn, an education technology specialist at the City University of New York*, 'education lags 30 years behind most of the world and 50 years behind Silicon Valley'* (Kahn, 2013). Learning is now more accessible than ever and its effectiveness is not only dependent on improvements in mobile hardware, network speeds and app development, but also on the way in which teaching content is communicated.

Before exploring video learning specifically, mobile learning must be studied as a whole. In doing so it is found that there are a variety of definitions on the subject, with an agreed definition yet to be established.

Kukulska-Hulme (2009: 158-159) believes this is because the field is '*experiencing rapid evolution*' and the differences in definitions are the result of the *'ambiguity of mobile'*, where it is unclear if mobile relates to mobile technologies or to the mobility of the learner. Some definitions are based on the physical mobility of individuals with the focus upon learners, whereas other definitions focus on the different technologies that are capable of delivering learning materials (Aljohani, Davis, Loke, 2012: 225). The 'ambiguity of mobile' is supported by Botha et al (2010: 33) who suggests the reason for such debate is because each definition reflects the community that puts it forward.

Botha et al (2010) describes two communities. Firstly, the solution based technology research community, who define mobile learning through mobile devices. Through this viewpoint Chen et al (in Botha et al, 2010: 33) describe learners as accessing mobile devices *to 'acquire and learn through a wireless transmission tool anytime and anywhere'*. This earlier research appears to concentrate on the technology itself. Similarly Quinn (2000) describes mobile learning as 'e-learning through mobile computational devices: Palms, Windows CE machines, even your digital cell phone'. Traxler (2007: 4) alleges that other definitions of mobile learning should be explored, as definitions such as this are *'constraining, techno- centric, and tied to current technological instantiations'*. The second viewpoint Botha et al (2010: 34) describe is the pedagogical view. This viewpoint addresses mobile learning from an educational perspective, where it is seen to *'enrich a particular learning environment and the learners'* experience of learning'. This identifies mobile learning as being complimentary to traditional forms of learning such as classroom based learning or e-learning, rather than as stand alone learning form in itself.

Traxler (2007: 4) believes that one should seek to explore other definitions that address the underlying learner experience, and the question should be asked: how does mobile learning differ

from other forms of education such as classroom based or e-learning? Kukulska-Hulme et al (2009: 21) believes that *'mobile technologies can support diverse teaching and learning styles, and lend themselves particularly well to personalised, situated, authentic and informal learning'*. Kukulska-Hulme and Traxler (2007: 181) when looking for the characteristics of mobile learning in literature found words such *as 'personal', 'spontaneous', 'disruptive', 'opportunistic', 'informal', 'persuasive', 'situated', 'private', 'context-aware', 'bite-sized' and 'portable'. This contrasted with words they found in e-learning literature such as 'structured', 'media-rich', 'broadband', 'interactive', 'intelligent'* and *'usable'.*

Although distinctions can be made between both in terms of the learners' experience, the defining factor between both forms of learning is its context. According to Sharples et al (2007: 236) it is really context that is the central construct of mobile learning that is created by people interacting with one another, within their surroundings, using everyday tools. Desktop technologies are described by Traxler (2010: 5) as operating in their own little world, where a dedicated time and place is reserved for the user to have *'his or her back to the rest of the world for a substantial and probably premeditated episode'*. Sharples et al (2007: 236) adds the classroom environment to this, which is founded on *'an illusion of stability of context, by setting up a fixed location with common resources, a single teacher and agreed curriculum'*.

In contrast to this classroom Traxler (2010: 5) describes mobile learning as operating in the real world, which is *'woven into all times and places of students lives'* and reconfigures *'the relationships between public and private spaces'*. He continues to highlight that mobile technologies are much more difficult to ignore as they are everywhere and they *'demolish the need to tie particular activities to particular places or particular times'.*

Where all parties appear to gain consensus is that mobile technology, much like learning, is ubiquitous. As highlighted by Kukulska-Hulm et al (2007) mobile learning is seen as an everyday activity where mobile technologies are tools to help people learn wherever they are, using training or informal support such as conversation. Traxler (2010: 3) supports this point and highlights that 'students no longer need to engage with information and discussion at the expense of real life, but can do so as part of real life as they move about the world, using their own devices to connect them to people, ideas, and information'.

A simple definition which will be used for this study is: mobile learning is any learning that occurs in a non-fixed location, where learners can utilise portable technologies on offer, to access learning content.

According to Sharples (2005: 6) every technological era has formed education in its own image, from the mass printed textbook to e-learning, and for the era of mobile technology we may conceive education as *'conversation in context'*, enabled by continuous interaction with mobile technologies. Although there has been much work and debate in the area of mobile learning, it is still seen as a new and evolving field where advances in handheld and wearable technologies will provide new and exciting opportunities for learners.

This empirical research is concentrates purely on mobile video content, which includes multimedia elements such as audio, visuals, video-text and animation. Firstly, mobile video learning needs to be defined. Although a number of definitions, sometime conflicting, for mobile learning are identified above, it is more challenging to find a clear definition for mobile 'video' learning. Previous studies such as Dominguez-Noriega et al (2012) have looked at interactive video learning using split screens with less focus on video content and more towards the interface built.

For this study mobile video content is defined as: 'any form of multimedia video content such as a teacher speaking to a camera, a lecture recording, slide show or whiteboard animation intended to teach a subject, that is accessed by the end user using a mobile device'. The mobile context in which the content is accessed such as public transport is not a pre-requisite, however, the content must be communicated through video and viewed on a device such as a smartphone or tablet.

The creation of mobile video teaching content can be seen as more complex than desktop video content due to challenges such as limited screen size that affects visual perception and attention (Maniar, 2008: 51), as well as the lack of control that users have on their environmental surroundings. As a result mobile video characteristics such as presentation style and video lengths become increasingly important in engaging users and capturing learners attention. These elements of mobile video learning are investigated in this study.

2.2.2 Impact of Mobile Video Learning

Developments in mobile learning will play a pivotal role in the future of education and professional development, not only complementing face-to-face and desktop learning, but also as a stand alone learning platform in itself. Little (2012: 402) describes the previous outlook on mobile learning where initially it was seen as *a 'minor but complementary technology to other forms of online learning'*, but over time has been 'increasingly prompted by the rapid growth in mobile devices and it is becoming a major delivery mechanism for learning and performance support materials'. According to Jones (2009: 1) mobile learning is now becoming *'an extension of distance learning providing a channel for students to learn, communicate, and access educational material outside of the traditional classroom environment'.* Increases in device technology and functionality have made this possible. As many of the world population already own mobile devices, educators are now beginning to see the overall potential that mobile learning has.

One of the big advantages of mobile learning is that its widely accessible. Melhuish and Falloon (2010: 3) describe mobile learning's greatest affordance as *'the ability to learn within ones own context when on the move in space and time'*. The integration of mobile learning into student's daily lives, where they can learn in any place at any given time is valuable. Mobile learning works as it can reach places that other methods of teaching cannot, empowering learners to decide when and where they will learn. Evans (2008: 492) adds that *'the use of portable technologies makes it easier for learners to study when and where they want by making it simple for them to transport their learning materials'*. This may be stating the obvious, but a major advantage of m-

learning is that mobile devices are lighter and therefore more potable than textbooks or laptops. Evans adds that mobile learning 'also facilitates *''just-in-time''* learning where learners can often take advantage of unexpected free time since they frequently have their devices with them". In today's working world, working hours are becoming more flexible. Little (2012: 402) supports this view stating 'workers at all levels in an organisation are increasingly comfortable with technology and so they are looking to that technology to help them wherever they are, whenever they need support, or have some spare time to develop their professional skills'. Learners such as this who are constantly on the move and often under time pressure, can take advantage of m-learning improve their knowledge and skills.

The second major advantage of mobile learning is that it is affordable. As mobile devices costs significantly less than PC's, mobile provides an inexpensive solution for learners (Mazouki, Idrissi and Bennani, 2013: 1). Online classes cost considerably less than face-to-face learning and there is also a plethora of online teaching content available at no cost to the learner. Websites such as Coursera and Udacity offer over 300 'massive open online courses', which enables user to get access to top university lectures from universities such as Harvard and Stanford, free of charge. Due to this affordability of mobile devices, according to a report by eMarketer it is estimated that by the end of 2014 it is expected that a staggering 1.76 billion people will own and use a smartphone device monthly, representing nearly one-quarter of the world's total population (eMarketer, 2014). What is particularly interesting about these figures is that they represent growth in the developing, as well as the developed world. This shows that mobile learning is scalable. Mobile learning can potentially influence the lives of over a billion people internationally providing educational opportunities to those who previously could not afford them.

Other benefits that are adapted from e-learning can easily be applied to the mobile field. Such examples are reduced cost and time savings for educational institutions, a self-developed and self-paced learning structure where students have unlimited access to learning material, and where a collaborative learning environment can be created by connecting learners to experts and peers, and allows material to be updated an maintained in a timely fashion (Zhang et al, 2006: 17). Mobile learning can also be used to re-engage today's youth with learning. According to Marzouki, Idrissi and Bennani (2013: 2) today's youth have a special relationship with their mobile device and they argue that learners gain more confidence when using their own technology, which can have great impact on their learning. Prensky (2001: 2) supports this suggesting today's youth *'think and process information fundamentally differently from their predecessors'*, and refers to this audience as 'digital natives' as they have grown up with technology. Mobile learning could be used to improve these learning experiences for younger users, and provide students with a bespoke and personalised approach to support their learning needs.

Although the benefits of mobile learning are evident it does come with its own challenges. Limitations of mobile learning include a smaller display screen size, limited battery life, slow mobile internet speeds, and reduced functionality of apps to accommodate the complete learning experience. The most notable challenge however is the development of a theory of learning, to support teachers in developing mobile video content. Although mobile learning can be delivered

through a variety of channels, this study will hopefully contribute somewhat to that theory in advising teacher creating mobile video content.

2.2.3 Characteristics of Mobile Video Learning to Consider

As the theory behind mobile learning develops, the onus is on both teachers and students to work together to try understand how these new technologies can be utilised for learning. The majority of literature within the m-learning space discusses mobile learning as a whole, rather than focus on a particular form of m-learning. This is certainly the case for mobile video, where limited research has been conducted with regards to engaging mobile learning content. Previous studies on mobile video learning have concentrated on technical aspects such as screen size (Maniar, 2008) or the mobile interface (Domingues-Noriega, Agudo and Santamaria, 2012), but none has focused on the content itself and how users perceive it. This study will focus on what video characteristics affect user engagement levels.

Video can influence a student's ability to learn in a number of ways. According to Maniar (2008) the benefits of video learning are: it can help students visualise how something works, it can show information that is difficult to explain using text and images; it can cater for different learning styles (especially for visual learners); and it can grab students attention motivating and engaging them with the subject. These benefits of video apply to mobile learning as they do to e-learning; however, e-learning materials are not easily replicated on a mobile devices as there are challenges such as the environmental context, the size of the screen; and video duration. Little (2008: 405) supports this viewpoint highlighting that *'a process whereby learning materials can be made into smaller 'bites' of learning which can be more easily delivered via a mobile device at the point of need'*, and goes on to state that *'content for mobile learning programs needs to focus more on essential information'*. Little suggests that due to the nature of learners mobility in public spaces, knowledge sought needs to be received in a timely fashion. Peng et al (in Melhuish and Falloon: 2010:9) agrees that mobile devices are not associated with deep learning experiences and is instead designed to be *"intuitive enough for high speed, short –term interaction"*. This theory is supported by research conducted by O'Hara et al (2007) who discovered that users who viewed TV episodes through mobile videos did so for very short viewing periods, sometimes even listening rather than viewing the content. These studies suggest that learners would benefit from short video lessons where they could take advantage of small fragments of free time to learn. Considering this literature, video duration as a characteristic will be investigated in this study to examine if participants disengage in video teaching content after a certain video duration is reached.

There is very little theory that recommends optimum duration times for producing mobile on video. Finamore et al (2011) compared YouTube traffic generated by mobile devices versus traffic generated by common PCs. As part of this research, they studied users behaviour behind the measures. They found that 60% of all YouTube videos watched were for no more that 20% of the video duration. Interestingly there was little difference between mobile device results and PC results, which suggests that the probability of aborting is not dependent on the device, but on the users habits. The video content in which YouTube is used for by the average consumer is extremely varied. However, the results from this study may suggest that participant's video

consumption on mobile devices is dependent on their general habits, both on mobile and desktop. This may be contrary to the research discussed above. In the context of mobile learning this may suggest that there is no need to reduce video learning duration times. See-To, Papagiannidis and Cho (2012) propose an interesting theory that the *'usefulness of mobile video should not necessarily be considered narrowly in the context of mobility, but also in conjunction with cases where the viewer is not on the move, but seeks a unemotional or experiential escape'*. It is true that a large amount of mobile video consumption happens outside of mobile environments but in other contexts such as the home. This was also observed by O'Hara et al (2007: 859) where solitary viewing occurred by participants in places such as the workplace when on their lunch break. Mobile viewing in this case enabled users to *'claim back their own time and space'* rather than socialise with colleagues. This is very different to mobile usage being consumed in traditional mobile contexts. As it is observed that users to escape into their own private environment commonly use mobile video usage, then these time periods have already been allocated with little chance of interruption. Therefore there is perhaps no need to make adjustment to desktop video lesson durations for mobile usage. Finamore et al (2011) found that 40-50% of all YouTube videos accessed using mobile devices were shorter than 3 minutes and that 5% of videos lasted longer than 10 minutes. These two video durations were measured in this study.

Papagiannidis and Appleby (in See-To, Papagiannidis and Cho, 2012: 1485) suggests four main dimensions, which the evaluation of mobile video could be made. They were *'quality of image and sound, location availability, time availability and choice of content'*. The second video characteristic that will be investigated in this study is related to the choice of video content, specifically the presentation style used to present the content. A new an exciting video presentation style is whiteboard animation, otherwise known as scribe. This video format is now more accessible and commonly used by teachers, due to developments in software such as LiveScribe where little technical knowhow or artistic ability is needed. Whiteboard animations are seen by some as a favourable alternative to the more common style of a lecturer speaking to a camera, or Powerpoint slides accompanied with audio. Gronstedt (2014: 69) describes a typical whiteboard video which features 'the hands of an artist drawing cartoons, headlines, diagrams, and arrows', while at the same time hearing a narrator talk in a casual style. According to Gronstedt sometimes this presentation 'is quickened, which creates a time-lapse or stop-motion effect'. A previous study was conducted by Cross et al (2013), which investigated two different presentation styles in an e-learning context. They compared handwritten recordings, which were recorded using a pen and tablet, to typeface presentations accompanied, often produced using Powerpoint. Although not the same style, as handwriting is a major element of whiteboard animations, this research was of interest. The results from the study proved inconclusive as no significant preference was found. Participants liked both presentation styles for different reasons, however those who preferred the handwriting style described it as "more personal", and those who preferred the typeface found it clearer and easier to read. Croft et al (2014) compared the use of animations and video when presenting teaching content to pharmaceutical students. They found that 73% of participants had a preference for the video, and only 3% had a preference for the animation, however they did think that the animation could be used in a patient pharmacist encounter. Whiteboard animations combine both animation and handwritten recordings. This study is the first, to the researcher's knowledge, to look investigate the whiteboard animated teaching style, certainly for mobile learning, and to measure its effect on user engagement levels and learning. Whiteboard animations will be compared to the more traditional style of a teacher speaking to a camera, accompanied by PowerPoint slides.

According to Kress and Pachler (in Melhuish and Falloon, 2010: 8) I. A goal of this research is to help identify what video characteristics affect m-learning to help provide teacher with insight to create engaging learning experience. In the following section we look at engagement and learning in more detail.

2.3 Engagement and Learning

2.3.1 Defining Engagement Related to Learning

Engagement is a term that has been defined on many occasions and its usually determined by its context. In the context of learning Kuh (in Robinson & Hullinger, 2008: 101) states "engagement pertains to the efforts of the student to study a subject, practice, obtain feedback, analyse and solve problems". This is quite a logical definition of engagement, which is devoid on any feeling on behalf of the student. A student could very well progress through all these learning stages and still feel disengaged by the content studied. Engagement in much more than this and instead it must be considered on a more personal level.

Lalmas et al. (2012) succeeds in doing so when they speak about engagement in terms of the user investing 'time, attention, and emotion'. Priego & Peralta (2013: 456) adds '*awakening learners curiosity'* to this. Engagement for some can be seen as being closely related to flow theory. Csikszentmihalyi (in See-To, Papagiannidis and Cho, 2012: 1486) describes flow as 'the holistic sensation that people feel when they act with total involvement', where enjoyment and engagement are the factors in flow theory. This can be experienced in a variety of scenarios such as music, dram and sports. In the context of this study engagement is certainly seen in term of user 'involvement' however the theory of flow suggests that when in the state of flow everything else is screened out. It is unlikely that a user, no matter how engaged they are in a mobile video lesson, could become totally oblivious to events going on around them. Therefore flow is seen to be too extreme a condition in this case.

In the context of this study the most accurate definition of engagement is provided by Schwartz and Hartman (2007: 9*): 'engagement can be characterised as the pull that brings people to a situation or topic and keeps them involved'*, and that it 'creates the mental context that prepares people to learn'. Emotion and student curiosity can be attributed to the 'pull' in this case and involvement is what keeps students captivated by the content. Unlike the definition provided by Kuh, this is the foundation from which students can then begin to learn. What is clear from all definitions is that engagement is seen as a positive experience for student, which can contribute to improving their levels of learning.

Lalmas et al. (2012: 165) divides user engagement measures into two groups 'self-reported engagement' and 'cognitive engagement'. In this study both self-reported engagement through user questionnaires and interview, and cognitive engagement through follow on tasks post video-lesson, will be reported. Through combination of both it is hoped that that the pitfalls of subjectivity described by Lalmas et al (2012) is avoided.

2.3.2 Concept of Immersion and Learning

A number of measures were explored from previous literature for ways to measure users engagement. A questionnaire was found in relation to flow (Rheinberg et al, 2003) however due to reasons mentioned earlier, and a lack of applicability to learning environments, this was rejected. A study conducted by Brockmyer et al. (2009) sought to measure engagement in video gaming through the development of a game experience questionnaire (GEQ). In this case engagement was used in terms of game 'involvement', which fit nicely with the definition of engagement previously chosen for this study. As part of the measure by Brockmyer et al. (2009), engagement was measured through different aspects of gaming experience such as immersion, presence, flow, psychological absorption and dissociation. Although the format of questions could be adapted to a learning context, after closer inspection its use was rejected as many of the questions were again focused on flow. Whereas previously it was determined that flow was too extreme to use in this case, an interesting find from the study was the concept of immersion. Banos et al (in Brockmyer et al. 2009: 624) defines immersion as *'the experience of the game-playing experience while retaining some awareness of one's surroundings'.* This seemed like it could be applicable to mobile video learning and therefore was investigated further.

Immersion is a topic that is being increasingly discussed in relation to education and learning. Due to technological developments virtual environments have been investigated in recent years, to help find new ways to increase student's immersion levels and ability to learn. According to Dede (2010: 66) 'immersive interfaces can aid in designing educational experiences that build on students' digital fluency to promote engagement, learning, and transfer from class room to real world settings'. Dede states that immersive interfaces can draw on the powerful pedagogy situated learning by 'enabling digital simulations of authentic problem-solving communities in which learners interact with other virtual entities (both participants and computer-based agents) who have varied levels of skills'. This is said to be more difficult to replicate in the traditional classroom environment. Dede (2010) suggests that immersive media may have the potential to release untapped intelligence and engagement in certain learners, and that effort should be made to understand how best to design this instruction. This is an interesting viewpoint, which suggests that immersive media experiences can attract digital savvy students to new forms of learning, and that these new forms may tap into student knowledge and interest, previously unknown. This technological advancement in new ways to teach students should be expected, especially considering the view by Prensky (2001) who describes today's youth as 'digital natives'. Mobile video learning, although a different form of media to virtual environments, is considered an immersive media experience. As highlighted by Dede a greater understanding is needed to design this type of instruction, but first the meaning of immersion must be identified and a way to measure it must be found.

As well as virtual reality environments, immersion is very much used in the area video gaming. Previous work by Brown and Cairns (2004) set out to use grounded theory to define the meaning of immersion, in the context of video gaming. They result was that immersion was used to describe the degree of 'involvement' with a video game and they found three levels: engagement,

engrossment and total immersion. Brown and Cairns (2004) suggest that the first level engagement refers to the gamers' preference and that 'if they don't like a game style they won't even try to engage with it'. After user interest is gained then time, effort and attention increases the level of engagement. This is quite similar to the definition of engagement discussed earlier by Schwartz and Hartman (2007) who described engagement not only in terms of 'involvement' in the action, but also the 'pull' that initially bring people to the topic. The second level of immersion according to Brown and Cairns (2004) is engrossment where there is a 'high level of emotional investment in the game'; this can lead players to feeling 'emotionally drained'. Finally the highest degree of engagement is total immersion where 'participants described being cut off from reality to such an extent that the game was all that mattered'.

For mobile video learning, although students are somewhat cut off from the world due to the use of headphones and viewing the screen, engrossment and total immersion seems too extreme to be applied to the learning context. Total immersion appears to share similar traits of detachment to flow discussed earlier. Instead, there are similarities between the first level of immersion highlighted by Brow and Cairns (2004), 'engagement', and the preferred definition of engagement for this study by Schwartz and Hartman (2007). Both share common language such as 'involvement' and describe the 'pull' or 'preference' of the user to initially interact with the game or lesson. Secondly Brown and Cairns (2004) suggest that time, effort and attention are then needed for engagement, which could be interpreted through the perspective of Schwartz and Hartman (2007: 9) creating 'the mental context that prepares people to learn'. For this study engagement will be measured with this first level of immersion in mind.

Jennett et al. (2008) explored immersion further in relation to video gaming. They attempted to measure immersion quantitatively using a measure they created called the 'immersion experience questionnaire' (IEQ). The creation of this questionnaire was influenced by previous work in areas such as flow, cognitive absorption and presence. Unlike the previous research conducted by Brockmyer et al. (2009), Jennett et al. make very clear distinctions of difference between immersion and flow. The grounded theory of immersion, defined by Brown and Cairns (2004) earlier, was used as the foundation for the questionnaire.

Although immersion does share some similarities with flow, cognitive absorption and presence, Jennett et al. (2008) highlight its distinctiveness such as the difference in extremity between immersion and flow, the fact that cognitive absorption is an attitude whereas immersion is an experience, and how presence is a state of mind where again immersion is about the experience. The IEQ questions were derived from a mixture of this previous work, and the result was a 31-item questionnaire that covered: basic attention (4 questions), temporal dissociation (6 questions), transportation (6 questions), challenge (6 questions), emotional involvement (5 questions) and enjoyment (4 questions). Each question was in the form of a statement and participants answered by their level of agreement using a 5-point likert scale (Appendix G).

Q.1. *To what extent did the game hold your attention?*
Not at all 1 2 3 4 5 A lot

Jennett et al. (2008) used a second measure, the single immersion question, whose purpose was to support participants IEQ results. Participants were asked:

Q.32. *'How immersed did you feel?'*

Participants were asked to rate their immersion a scale of 1-10, where 10 signified 'immersed' and 1 'not immersed at all'. These results were then compared to the participants IEQ results. In testing the IEQ through a series of experiments it was found that there was a strong correlation with SIQ measures of immersion, which proved the IEQ was accurately reporting participants levels of immersion.

The questionnaire developed by Jennett et al. (2008) appears theoretically sound, and is thorough in its measure of immersion, approaching the subject from a number of psychological perspectives. This questionnaire was the most reliable measure of immersion found when compared to others from previous literature; therefore it has been adapted for this study. In the questionnaires adaptation to a learning environment, a small number of questions appeared more focused towards video gaming, specifically two questions concerned with interactivity. Otherwise the questionnaires accuracy was sound and it was hoped that it could be utilised to measures learner's levels of immersion when view mobile video lessons.

2.3.3 Factors that Affect Immersion

A later study conducted by Jennett (2010) identified five main components of immersion developed using Cattell's scree plot, which could be measured using the IEQ. These were identified as a mixture of psychological factors (cognitive involvement, emotional involvement, real world dissociation) and game factors (challenge, control). Jennett (2010) describes the meaning of each in figure 2.1.

Immersion Factor	Description
Cognitive Involvement (CI)	Strong loadings with items expected to measure effort and attention, e.g. "To what extent did you feel focused on the game?"
Emotional Involvement (EI)	Strong loadings for items expected to measure affect and suspense, e.g. "To what extent were you interested in seeing how the game's events would progress?"
Real World Dissociation (RWD)	Strong loadings for items expected to lack of awareness of surroundings and mental transportation, e.g. "To what extent did you feel consciously aware of being in the real world whilst playing?"
Challenge	Strong loadings for items expected to measure how

(CH)	difficult the user found the game, e.g. "Were there any times during the game in which you just wanted to give up?"
Control (CON)	Strong loadings for items expected to measure the ease of the use of the gaming interface, e.g. "At any point did you find yourself become so involved that you were unaware you were even using controls?"

Fig. 2.1

These factors are an interesting insight to the components of immersion that could provide a more in depth analysis on the subject. On inspection these immersion factors could be applied to mobile video learning, possibly with the exception of 'control' as it appears to be more focused towards interaction with the gaming controls. Jennet elaborates that it is not clear what characteristics contribute to these immersion factors in terms of video gaming and how the factors relate to one another, however is this study characteristics of mobile video lessons can be explored.

Real world dissociation is certainly a relevant measure for this study as the act of using headphones and viewing a screen on a smartphone device has the potential to shut users off from their surroundings. Through the manipulation of video characteristics it could be determined what ones were most effective for real world dissociation. The same experiment could be conducted for cognitive involvement (user focus), emotional involvement (user suspense) and challenge (difficulty). This would highlight what characteristics of mobile video lessons teachers should consider.

In the context of this work the measurement of these immersion factors would prove useful, therefore they will be experimented in more detail in Chapter 4 (Experimental Research Findings).

2.4 Emerging Issues and the Need for Empirical Research

This study of previous literature has shown that the field of mobile video learning is new, complex and an area that is constantly evolving due to developments in mobile hardware and software. It was identified that there was little to no agreement in terms of a universal definition for mobile learning. For the purpose of this study a definition was created that defined from the perspective of the learner: 'mobile learning is any learning that occurs in a non-fixed location, where learners can utilise portable technologies on offer, to access learning content'. Regarding mobile video learning content no definition was found, therefore for this study is it defined as 'any form of multimedia video content such as a teacher speaking to a camera, a lecture recording, slide show or whiteboard animation intended to teach a subject, that is accessed by the end user using a mobile device'.

The potential impact and benefits of mobile video learning were then identified (Evans 2008, Mazouki, Idrissi and Bennani 2013). The review of the literature stressed the need for learning theory to be developed, to better facilitate teachers in the creation of mobile content (Melhuish and Falloon 2010). Through this support system, mobile video learning could be used to its full potential to help people worldwide engage in learning content tapping into knowledge previously unexplored. Previous research was studied that compared alternative video learning formats for e-learning (Croft et al 2014, Cross et al 2013), yet no research to the researcher's knowledge has been conducted using mobile devices. A new and potentially engaging presentation format, whiteboard animation, was identified (Gronstedt 2014) and suitable video durations to test were decided (Finamore et al 2011).

In testing these alternative video characteristics a measurement system was established from previous research. Engagement was defined as the 'pull that brings people to a situation or topic and keeps them involved', creating 'the mental context that prepares people to learn' (Schwartz and Hartman 2007). This was then attributed to immersion (Brown and Cairns 2004) and measured using the immersion experience questionnaire (Jennett et al. 2008).
The need for user-based research is vital in establishing a solid theory to facilitate in the creation of mobile video based learning. To establish a comprehensive understanding of mobile video learning, empirical research will be conducted. This research will attempt to identify the characteristics that make mobile video content engaging, and prove that a relationship exists between participant's engagement levels and that ability to learn.

The following chapter will specify the research methodology to be used in this study, which will include the hypothesis to be tested, research measures used, data collection techniques and detailed analysis of results.

3. Research Methods

3.1 Research Overview

The purpose of this research was to investigate video learning using smartphone devices.

The following questions were considered:

1. What characteristics of educational videos on smartphone devices make them more engaging to users?

2. What effect does engagement have on learning when using smartphone devices?

There has been a rise in mobile learning interest in recent years and this format is becoming increasingly popular. However, the study of video characteristics and engagement levels related to mobile learning has been relatively unexplored. In Chapter 2 (Literature Review) a gap was identified in the existing research in that previous studies have focused on mobile learning in the general sense and its potential impact on learning (Kukulska-Hulme: 2009; Botha: 2010; Traxler:

2010), whilst others have looked at the technical aspects of video learning such as screen size and user interface (Maniar: 2008; Domingues-Noriega et al: 2012). Users' engagement has been studied but only in relation to e-learning (Robinson and Hulligar: 2008; Priego and Peralta: 2013).

Presently no research has been conducted to determine what characteristics create a more engaging mobile learning video experience for users. Sharples (2005: 6) describes mobile learning as a *'conversation across multiple contexts'* that takes place outside the classroom in a variety of different environmental settings. This research is the first step in uncovering what makes those 'conversations' engaging to users. Further it has also yet to be proved whether engagement does in fact affect users' ability to learn when using mobile video lessons on smartphone devices. This will also be examined in more detail.

For this research the most effective way to meet these objectives is through an experimental study working closely with participants. An important contribution of this research will be the study and analysis of empirical data on users' attitudes towards mobile video characteristics, and establishing how much they learn when presented with different types of video content. Although the focus is to uncover findings related to video characteristics, engagement and learning, this research is novel as it will also indentify how engagement can be measured with regards to mobile video learning, thus providing a new framework which can be used in future research. Through combining the research from the literature review with the results uncovered in the participant study, the researcher hopes to formulate a better understanding of the mobile video learning space, and contribute useful knowledge to help create more engaging content for learners.

This section will discuss the strategy used to answer these objectives; how the mobile video content was designed; how data was collected; and how the analysis of the findings was conducted. It will also discuss the changes made to the design approach as a result of findings from the pilot study as well as potential limitations.

3.1.1 Experiment Design Overview

The goal of this research was to uncover learner's preferences towards certain mobile video characteristics, and the effect these characteristics have on their engagement levels and learning. Given this is the first study of its kind, it was decided that the best way to understand smartphone video learning was to create a mobile learning experience. An experimental research method was used to achieve this objective and the primary focus was participants who were interested in the subject of entrepreneurship but who had not been formally trained on the subject.

The overall research hypothesis, which was informed by research in fields such as mobile and engagement, was:

As smartphone video characteristics such as length and presentation style change, so will users' engagement levels and ability to learn.

A within-groups participant design was chosen for this study. This reason being that it enabled a larger contribution of data from a smaller group of participants. Participants were asked to watch six different video lessons using a smartphone device. To avoid bias towards a particular video lesson, the video order of viewing for each participant was randomly selected.

Independent Variables

The two independent variables for this study were video presentation style and duration. Two alternative presentation styles were chosen for three videos each. Each presentation style had three video durations: 3 minutes, 5 minutes and 10 minutes. This will be discussed in more detail in section 3.2.1 (independent variables).

Dependent Variables

The two dependent variables measured were engagement and learning. The aim was to explore if there was a relationship between users' engagement levels and their ability to learn. Although this may seem obvious, to the researcher's knowledge it had never been investigated on smartphones. Further details on the dependent variables chosen will be discussed in section 3.2.1 (dependent variables).

Those who participated in the study were from a variety of backgrounds. The only two requirements were that participants have an interest in entrepreneurship, and that they had not been formally trained on the subject. A total of 24 participant sessions took place between September 17th and October 16th 2014.

In describing a brief overview of the study, each participant was seen individually in a similar private setting. It was important that the study be conducted in similar settings so participants had the same experience. During the session they were asked to watch six separate video lessons using a smartphone device. After each lesson their levels of immersion were measured and their learning tested.

In essence this research is primarily quantitative in nature. However, understanding mobile learning requires a more in depth approach. Qualitative techniques such as a background questionnaire and semi-structured interview were therefore used to explain participant's behaviour. It is hoped that this experimental approach will help address the issues highlighted earlier in the literature review.

3.1.2 Reducing Experimental Bias

As highlighted by Lazar et al (2010), a common problem associated with within-participant studies is learning effects. This is when participants gradually get better at completing a task as they experience it multiple times under multiple conditions. Other potential pitfalls that can affect experimental bias are participant fatigue and boredom. This study was cognitively demanding as it involved viewing a number of video lessons, completing exams, and then feeding back on opinion

through questionnaires. Therefore it was expected that fatigue would take effect at some stage, especially for the longer video lessons.

To address this problem each participant was shown the 6 selected videos in random order. This was done to avoid any bias towards a particular video lesson dependent on the order they were viewed. This protected the reliability of the study's results.

To address these order effects a Latin square approach was considered. However, as the video lessons involved two presentation styles and three different durations, a Latin square was needed that accounted for two different factors. A Graeco-Latin square (Box, Hunter and Hunter, 2005: 167), was considered but as there were potentially 720 permutations and only 24 participants, true randomisation was not achievable. As the Latin square could not be used for true randomisation it was instead decided to draw the order of each participant's videos sequence from a hat. This simplified approach was used as the method of random selection for the six independent video conditions and was considered reliable. It was conducted prior to the participant study and the order of each participant's videos can be seen in Fig. 3.1 below.

Participant	Video Order	Participant	Video Order
1	A1, B1, A2, B3, B2, A3	**13**	B1, A3, B3, B2, A1, A2
2	B3, B2, B1, A1, A2, A3	**14**	B2, A3, B1, A2, B3, A1
3	A1, B2, A3, B1, A2, B3	**15**	A2, B2, A3, B3, B1, A1
4	B2, A1, B3, B1, A3, A2	**16**	B3, A3, B2, A2, B1, A1
5	A1, B2, B3, A3, B1, A2	**17**	A3, A1, B1, B3, B2, A2
6	B2, A2, A1, B1, B3, A3	**18**	B1, A3, B3, B2, A2, A1
7	A2, A1, B2, B3, B1, A3	**19**	B1, A3, A2, B3, A1, B2
8	B2, A3, B3, A2, A1, B1	**20**	B2, B1, B3, A2, A1, A3
9	A2, B3, B1, A1, B2, A3	**21**	A1, B1, A3, B2, A2, B3
10	B3, A2, B2, A3, A1, B1	**22**	A3, B3, B1, A1, B2, A2
11	A1, B2, B1, A2, B3, A3	**23**	B2, B1, A2, A3, B3, A1
12	A1, A3, B3, B1, A2, B2	**24**	A3, B1, B3, B2, A2, A1
(Pilot)	A1, B1, A2, B3, B2, A3		

Fig.3.1

3.1.3 Data Collection and Analysis

A stringent system was implemented to collect and analyse participant's data, which helped improve recording accuracy and minimise researcher error. For the study participants were required to complete 6 questionnaires, 6 post-lesson exams, a background questionnaire, and a post-study interview. Due to the amount of data collected, this system was tested thoroughly in the pilot session to ensure accuracy.

As this research was mainly quantitative, 3 separate measures were taken for the 6 videos lessons chosen. These measures are discussed in detail in section 3.4 (Data Collection). All data was recorded using Microsoft Excel and then transferred to SPSS version 22 for further analysis. These files can be found on the accompanying USB stick.

Given the nature of this research, qualitative data was also gathered to delve deeper into participant's results. User opinions gathered from semi-structured interviews were audio recorded to ensure accurate reporting and then transcribed to Microsoft Word **(Appendix P)**.

SPSS 22 was used to analyse they study's quantitative data, details of which can be found in section 3.7.1 (Quantitative Analysis). Statistical tests were conducted in SPSS to investigate the study's research objectives. Qualitative data from interviews and background questionnaires were analysed and then categorised into themes. This helped inform participants SPSS results.

3.2 Hypotheses

In relation to the overall research hypothesis that mobile video characteristics affect engagement and learning, each dependent variable measure, engagement and learning, has a null and alternative hypothesis.

H_0: There is no difference in participant's levels of engagement related to the duration of a mobile video lesson.

H_1: There is a difference in participant's levels of engagement related to the duration of a mobile video lesson.

H_0: There is no difference in participant's levels of engagement related to the presentation style of a mobile video lesson.

H_1: There is a difference in participant's levels of engagement related to the presentation style of a mobile video lesson.

H_0: There is no relationship between participant's levels of engagement and their ability to learn using a smartphone device.

H_1: There is a relationship between participant's levels of engagement and their ability to learn using a smartphone device.

Previous research suggests that users prefer shorter rather than longer videos, when using mobile devices (O'Hara at al. 2007; Little 2008; Melhuish and Falloon 2010). It was expected that as videos get longer, participants would become less engaged. Therefore the first hypothesis was treated as 1-tailed.

There was no evidence in previous research to suggest that the two remaining hypotheses should move in any specific direction. It is unknown if one presentation style will be more effective than the other for participant engagement, and it has yet to be proven that engagement is related to learning using smartphone devices. As a result the final two hypotheses were treated as 2-tailed.

3.3 Research Measures

3.3.1 Independent Variables

An objective of this research was to examine the effect that changes in video characteristics had on a participant's engagement levels and their ability to learn. Many characteristics of video lessons could have potentially been explored such as alternative topics of content; changes in instructors; or exploration of interactive videos; however it was considered that for this study the most important and universal characteristics to address were:

1) Presentation styles and
2) Video durations

The beginner's level subject 'How to build a start-up' was used for both presentation styles and taught by the same instructor.

Presentation Styles

Two alternative presentation styles were chosen:

1. A whiteboard animated lesson, with an instructor voiceover; and

2. An teacher presenting to a camera face-to-face, accompanied by on screen Powerpoint slides

These two presentation styles were chosen as one represents a new and exciting form of whiteboard technology, whereas the other represents a well-established teaching style.

Whiteboard animated video is an innovative technology that is now becoming more accessible to teachers. This new style of teaching uses animated graphics and is widely considered to be effective in increasing learner's engagement levels. This style was compared to the 'teacher with slides' presentation style, which is more representative of the traditional lecture environment. Both styles represent alternative ways to communicate a teaching subject to participants using a smartphone device and were investigated to discover if one style worked better than the other. As the whiteboard animated lessons were predominately visual, it was interesting to ascertain if these graphics would be easily visible to users using a smaller Smartphone screen.

Video Duration

The second characteristic explored was video duration. Changes to video lesson lengths were made to examine the effect that this would have on participant's engagement levels and their ability to learn. Each presentation style included videos of three minutes, five minutes and ten minutes in length.

These times were influenced by the research conducted by O'Hara et al (2007) and Södergård (2003). Both studies found that participants prefer shorter video viewing times when using mobile devices. This was due to factors such as small screen size and surrounding environments. Presently the ideal length for video lessons using smartphone devices is unknown. No research has been conducted on the matter. It was further considered that the time people spent on mobile devices is more compressed than desktop usage, where interactions are often shorter and sharper, therefore overall shorter video lengths were considered to be more suitable for users.

Finamore et al (2011) conducted a study investigating users YouTube behaviour both on desktop PCs and mobile devices. They found that 40-50% of all videos accessed from mobile devices were shorter than 3 minutes, and 5% of videos lasted longer than 10 minutes. Both video durations were considered for this study.

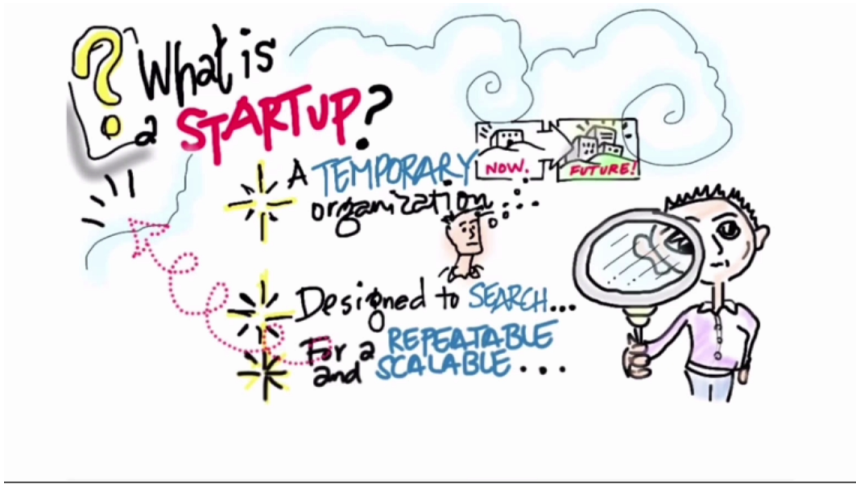
In the context of a video lesson only so much content can be communicated from a teacher to a student within 1-minute. It was decided that 3 minutes was the shortest suitable time for a student to gain a good understanding of a beginner's level subject.

The length of 10 minutes was chosen as an extreme variable, as it was felt that unless the user was in a public environment without interruption for a 10-minute period, it was unlikely that the full length of the video lesson would be viewed.

The last length chosen video duration was 5 minutes, as it was seen as a reasonable mid-point between the two other times. It was judged that this length could potentially show significant difference in participant scores when compared to 3 minutes, and was a reasonable time likely to be viewed by participants using smartphones.

Figure 3.2 below shows examples of both video presentation styles and variations in video length.


INTERMEDIATION FEE
Often found in marketplaces of various types, a fee for bringing together two or more parties involved in a
|<
Next video >|
03:35
05:12


What is a STARTUP?
A TEMPORARY organization
NOW.
FUTURE!
Designed to SEARCH...
For a REPEATABLE and SCALABLE...


CUSTOMER DISCOVERY
3. Analysis & Insight
Next video >|
01:34
03:09

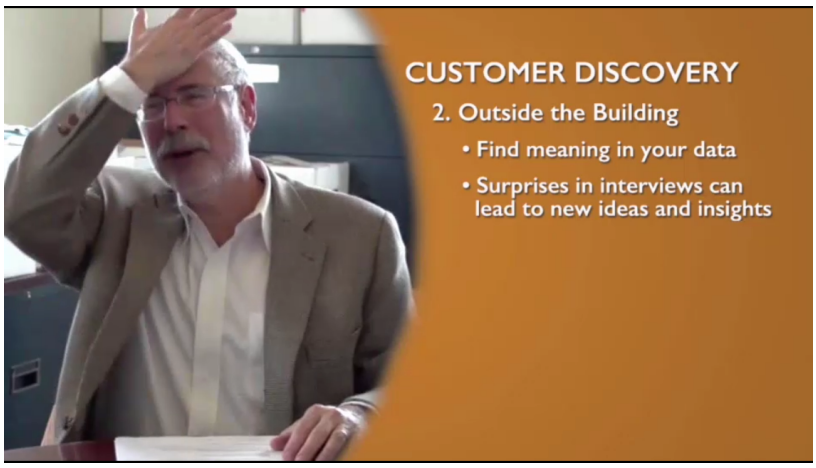


Fig. 3.2 Examples of Whiteboard Animation (WBA) and 'Teach With Slides' (TWS) lessons.

3.3.2 Dependent Variables

To achieve the objectives set out in this study two dependent variables were measured:

1) Engagement; and
2) Learning.

Engagement

As discussed in Chapter 2 (Literature Review), the researcher defines learner's engagement in terms of immersion, which describes the degree of 'involvement' that a participant has with a video lesson. Participants' levels of immersion were measured in two ways.

Firstly the Immersion Experience Questionnaire (IEQ) was used. This was a questionnaire originally used by Jennett et al (2008) to measure and define the experience of immersion in video gaming. This questionnaire had never been used before to measure mobile video learning, therefore it is a new and novel approach. Although the questions were originally formulated for video gaming, they were also applicable to mobile video learning. By combing the scores for certain sets of questions, factors of participant immersion can be calculated such as cognitive involvement; real world dissociation; emotional involvement; challenge; and control. This questionnaire was seen as an excellent fit for this study considering its objectives.

To ensure the accuracy of the IEQ a second measure of immersion was taken, the single immersion question (SIQ). Its purpose Jennett (2010: 25) claims is *"to show that the IEQ is accurately reflecting peoples own understandings of immersive experiences".*

This single question asks:

'How immersed did you feel?' (10 = very immersed; 0 = not at all immersed).

The higher that participants scored for both the IEQ and SIQ, the more they were seen to be engaged in the video lesson content. Although Jennett et al. (2008) had previously proved that there was a correlation between IEQ and SIQ scores this had yet to be proved for mobile video learning. This was tested as part of this research.

Participant Learning

A post-lesson examination was used to measure what participants had learned from each video lesson. This exam was taken after the IEQ and SIQ were completed.

As the characteristics presentation style and videos duration were manipulated, it was expected that participant exam results would show differences in learning. Examination results were also compared to participant's IEQ scores.

The reason for the choice of these two dependent variables was to explore if there was a correlation between immersion and learning using smartphone devices. Through manipulation of the independent and the measurement of immersion and learning, this research could explore what video characteristics create an immersive mobile video learning experience, and whether immersion has an effect on learning.

3.3.3 Qualitative Data

A third participant research measure was obtained through qualitative data in the form of a post-lesson semi-structured interview. This was used to build a detailed picture of why participants performed the way they did. Participants were encouraged to feedback their feelings on preferences towards particular styles and durations of videos. This helped describe the complex nature of mobile video learning through the participant's own language and helped gain a personal insight to the participant's experience of a task that many had not experienced before. The interview was semi-structured giving participants the freedom to express themselves in their opinions. Results were combined with both learning and immersion measures to formulate a three-dimensional view of the subject. Participants also provided qualitative information through a pre-study background questionnaire. This will be discussed in the following section.

3.4 Data Collection

3.4.1 Background Questionnaire

Before the experiment began participants were asked to complete a short 12-question background questionnaire **(Appendix J).** The questionnaire consisted of a combination of closed, open and multiple-choice questions. The purpose of the questionnaire was to gain insight into participant's backgrounds such as their gender, age group, profession or chosen academic subject if a student. The background questionnaire was used to inform any obvious patterns that may have emerged from participant results. This could then be investigated further at a later date.

Participant's daily smartphone usage was explored, as was their general attitude toward mobile video learning.

3.4.2 Immersion Experience Questionnaire (IEQ)

The Immersion Experience Questionnaire (IEQ) originally used by Jennet at al. (2008) to measure immersion in video gaming, was used to measure participants immersion scores after viewing each video lesson. Minor changes were made to the questionnaire such as the wording of 'game' to 'video lesson', but for the most part the questionnaire stayed true to its original form. Participants were given a statement and then asked to rate their level of agreement or disagreement on a likert scale of 1-5.

Examples of IEQ questions can be seen in Figure 3.3 and full questionnaire can be found in **Appendix L**.

To what extent did the video lesson hold your attention?						
Not at all	*1*	*2*	*3*	*4*	*5*	*A lot*

To what extent did you lose track of time?						
Not at all	*1*	*2*	*3*	*4*	*5*	*A lot*

To what extent did you notice events taking place around you?						
Not at all	*1*	*2*	*3*	*4*	*5*	*A lot*

To what extent did you find the video lesson challenging?						
Not at all	*1*	*2*	*3*	*4*	*5*	*Very difficult*

Fig.3.3

By calculating the result of the 31-questions, participants immersion levels could be determined. The total score that each video lesson could achieve from the IEQ was 155 points. It is worth noting that a number of the 31 questions were negated (Q6, Q8, Q9, Q10, Q18, Q20), therefore adjustments had to be made to participant scores in calculating their final immersion results.

For example question 6 in Figure.3.4 asks:

What extent did you feel consciously aware of being in the real world whilst viewing?						
Not at all	*1*	*2*	*3*	*4*	*5*	*A lot*

Fig.3.4

In this particular example if a participant scored a five on the scale this would be seen as a negative result. In this case the scale was flipped with the score of five being converted to a one.

In Figure 3.5 we can see a sample of a participant's IEQ scores for all six video conditions. In this case whiteboard animated video lessons are labelled WBA, and 'teacher with slides' videos are labelled TWS. The video duration for each is indicated in the video title.

	IEQ. WBA. 3min	IEQ. WBA. 5min	IEQ. WBA. 10min	IEQ. TWS. 3min	IEQ. TWS. 5min	IEQ. TWS. 10min
P1	114	111	96	116	114	85

Fig. 3.5

Through observation of the above table we can see that participant 1 appears to be more immersed with shorter rather than longer video durations. There does not appear to be much difference in immersion scores between both video styles. However, for both presentation styles there appears to be a significant drop in immersion levels between the 5-minute and 10-minute video durations. Data such as this is explored in further detail using SPSS in Chapter 4 (Results and Discussion).

Two questions in particular (Q11, Q16) on the Immersion Experience Questionnaire appeared to be more suitable to video gaming rather than mobile video learning. These were:

To what extent did you feel you were interacting with the video environment?						
Not at all	*1*	*2*	*3*	*4*	*5*	*A lot*

To what extent did you feel as though you were moving through the class according to your own will?						
Not at all	*1*	*2*	*3*	*4*	*5*	*A lot*

Fig. 3.6

It is clear that these questions are more specific to video gaming, as the smartphone video lesson did not provide participants with an opportunity to interact. Participants also had little impact on how the video lesson was progressing. During the study participants were asked to answer all questions to the best of their ability. In order to stay true to the original theoretically sound questionnaire these questions were included. It was hoped that 2 less suitable questions from 31 would have little impact on the overall result. However, it is with this in mind that IEQ results should be treated with a degree of caution, as the discrepancies mentioned may affect the reliability of results.

The IEQ can also be used to explore factors of immersion such as cognitive involvement; real world dissociation; emotional involvement; challenge; and control. Each factor can be measured by combining the total score for a series questions. For example the cognitive involvement factor can be calculated by combining participants' responses for 10 questions: Q1, Q2, Q3, Q4, Q17, Q19, Q21, Q22, Q25, Q29. Each separate immersion factor and its formula for calculation can be found in **Appendix L**.

This further measure of immersion factors was developed by Jennett (2010), on a study of video game immersion and selective attention. This study on mobile learning uses the Immersion Experience Questionnaire used by Jennett et al. (2008), which uses a 5-point likert scale. This differs to Jennett's 2010 study where a 7-point likert scale was used. There does not appear to be an explanation for the change in likert measures, however the questions for both questionnaires remain identical. Also these 5 immersion factors are in fact identified in the earlier work from Jennett et al (2008). The reason the 7-point likert scale was not used for this study was because this research was conducted before Jennett's second piece of research was identified.

Although the measure of these factors is not paramount to the original objectives of this study, they are explored in Chapter 4 (Results and Discussion). Questions 11 and 16 mentioned earlier that do not quite apply to mobile video learning, are two of eight questions used to measure the immersion factor 'control'. It is for this reason that scores for 'control' will not be used.

3.4.3 Single Immersion Question (SIQ)

To prove the validity of the immersion experience questionnaire participants were asked a single immersion question after each video lesson. The question was positioned at the end of the IEQ where participants were asked how immersed they felt after watching the previous video. This was a technique used by Jennett et al. (2008) and Jennett (2010), to ensure the IEQ is in fact proving an accurate measure of participant immersion. Although Jennett et al. (2008) proved that there was a relationship between the IEQ and SIQ using a Pearson correlation, this had not yet been proved for mobile video learning. As briefly mentioned in section 3.3.2 (Dependent Variables) part of this research is to determine the relationship between IEQ and SIQ for mobile video learning.

Throughout this research the single immersion question was used in ways that it had not been used before. Whereas previously the SIQ was used solely to prove the validity of the IEQ through a correlation, in this study the SIQ was examined in more detail. Single immersion question scores were examined across all six video conditions. Significant differences in results were then explored in more detail between video conditions and were visually plotted to inspect if they reflected the IEQ results. A correlation was also run between the SIQ and post-lesson exam scores to investigate if it is possible that the SIQ could be used alone without the more detailed IEQ to measure immersion related to learning. This is a novel approach to this study.

Below in Figure 3.7 a sample of our SIQ results can be observed compared to the IEQ scores identified in Figure 3.6

	IEQ. WBA. 3min	SIQ. WBA. 3min	IEQ. WBA. 5min	SIQ. WBA. 5min	IEQ. WBA. 10min	SIQ. WBA. 10min	IEQ. TWS. 3min	SIQ. TWS. 3min	IEQ. TWS. 5min	SIQ. TWS. 5min	IEQ. TWS. 10min	SIQ. TWS. 10min
P1	114	7	111	7	96	5	116	8	114	7	85	4

Fig. 3.7

If the scores for participant 1 are again investigated, it can be seen that their SIQ scores appear to reflect their IEQ results for all six videos. Further analysis of SIQ scores can be found in Chapter 4 (Results and Discussion).

3.4.4 Post-Lesson Exam

The impact that each video lesson had on participant's ability to learn was explored using a post-lesson examination. To speed up the study and to avoid participant confusion for all 6 exams, participants were asked:

"If you were to explain what you have learned from that video to somebody else, what would you tell them?"

Participants were encouraged to use bullet points and sentences for each separate point. After each video participants were allocated two thirds of the video duration time to type what they had learned for ease of recollection. If they were finished within the allocated time they informed the researcher and moved on to the next lesson. Below are the examination times allocated for each lesson:

- Video Lesson: 3:00 – Examination Time: 2:00
- Video Lesson: 5:00 – Examination Time: 3:20
- Video lesson: 10:00 – Examination Time: 6:40

This simplified approach was chosen for two reasons. First, it was very clear to participants what was expected of them after each video lesson. As participants had a number of questionnaires and exams to complete in the study, it was important that they moved through the process quickly. By asking participants to repeat what they had learned it helped keep their newly acquired knowledge fresh in their mind. If they had to read examination questions given, they may have posed further questions. Also the content of the questions may have reminded participants of information already forgotten. Second, this method was used to reduce the experimenter effect as questions for certain video lessons may have been more difficult than others. This is where a

researcher's bias can unconsciously influence an experiment (Venkatesan, 1967: 142). Although the six videos were on the same topic of 'how to build a start-up', the content for each was very different. The one question method used for the post-lesson exam reduced the likelihood of experimenter influence affecting the final data.

Finally it was vital that a clear examination correction criterion be put in place, which can be found in **Appendix N**. This was to ensure that participants' results, if corrected by another examiner using the same criteria, would remain the same. For each lesson two marks were allocated for a correct point fully constructed, one mark for a point made but not quite fully formulated, and zero marks for an incorrect point made. As each individual video had a different amount of content, total scores for each lesson differed. Participants were awarded a percentage mark of what they scored from that total.

3.4.5 Semi-Structured Interview

Although the post-lesson interview added more time to what was already a lengthy study, it was seen as essential in obtaining extra opinion from participants that might not have been uncovered through the questionnaires or exam scores. The interviews were semi-structured to ensure they had a direction, but they also provided a sense of freedom for participants to express their views.

In total 6 questions were asked which can be found in **Appendix P**. One reason for using the interviews was to uncover if participants had preference towards one presentation style. They were then asked if they felt that they learned more from their favoured style. It was important to establish if participant opinion was consistent with their examination performance. It was also interesting to discover if participant's presentation preference also reflected their IEQ results. On the surface due to impressive graphical animations whiteboard videos appear more polished when compared to the 'talking head' presentation style. It may have been that participants performed better in IEQ and learning scores for the traditional presentation style.

Using the interviews participants' attitudes towards the duration of video lessons were established. One hypothesis for this study was that there would be a noticeable difference in participant's levels of immersion as the duration of video lessons increased. Further insight was gained into participant's views on this matter, which was used to elaborate on the results uncovered from the data.

Participants were also asked about their experience of watching the video lessons using a smartphone device and if it influenced their ability to learn. In a previous study participants were found to have positive opinion of mobile learning despite the reduced screen size (Maniar et al 2008). The question was also used to raise any issues in relation to either of the presentation styles. As screen size was smaller it may have been more difficult for participants to make out certain animated graphics or text on slides.

A final question was asked on what it meant to participants to be 'immersed' in a video lesson. The question was used to gauge if participants had a good understanding of the term 'immersion'. Responses to the question were accurate however; the researcher may have made a mistake. Participants were asked what their understanding of immersion was at the end of the study. As participants had already answer 6 immersion questionnaires by this stage, their answers may have been influenced by the IEQ questions. In hindsight it would have been more valuable if this question was asked in the background questionnaire at the beginning of the session.

Despite this, the post-lesson semi-structured interview proved valuable in informing this research.

3.5 Participant Recruitment

In total 26 participants were recruited for the study, with 24 participants included in the final results. As significant adjustments were made after running the pilot session, this data could not be used in the final analysis. A second participant's data could also not be used due to their level of English, finding difficulty in both understanding the video content, and communicating with the researcher.

Convenience sampling was used to recruit participants through advertising on the City University campus and through the researcher's personal contacts. A poster campaign was used to recruit participants from City University (Fig. 3.8), and an email advertisement was sent from the University's entrepreneurial support service to all City students (Fig. 3.9).

Respondents that showed an interest in participating in the study were emailed the study screener and asked to respond. This was also present on the day of the experiment. On occasions participants were screened through telephone conversations prior to the study. The criteria for participation was that participants needed to be interested in entrepreneurship, but not have received any formal training through a workshop or from an academic institution on the subject. As the content was mainly theoretical, participants who had experience of running their own businesses were included.

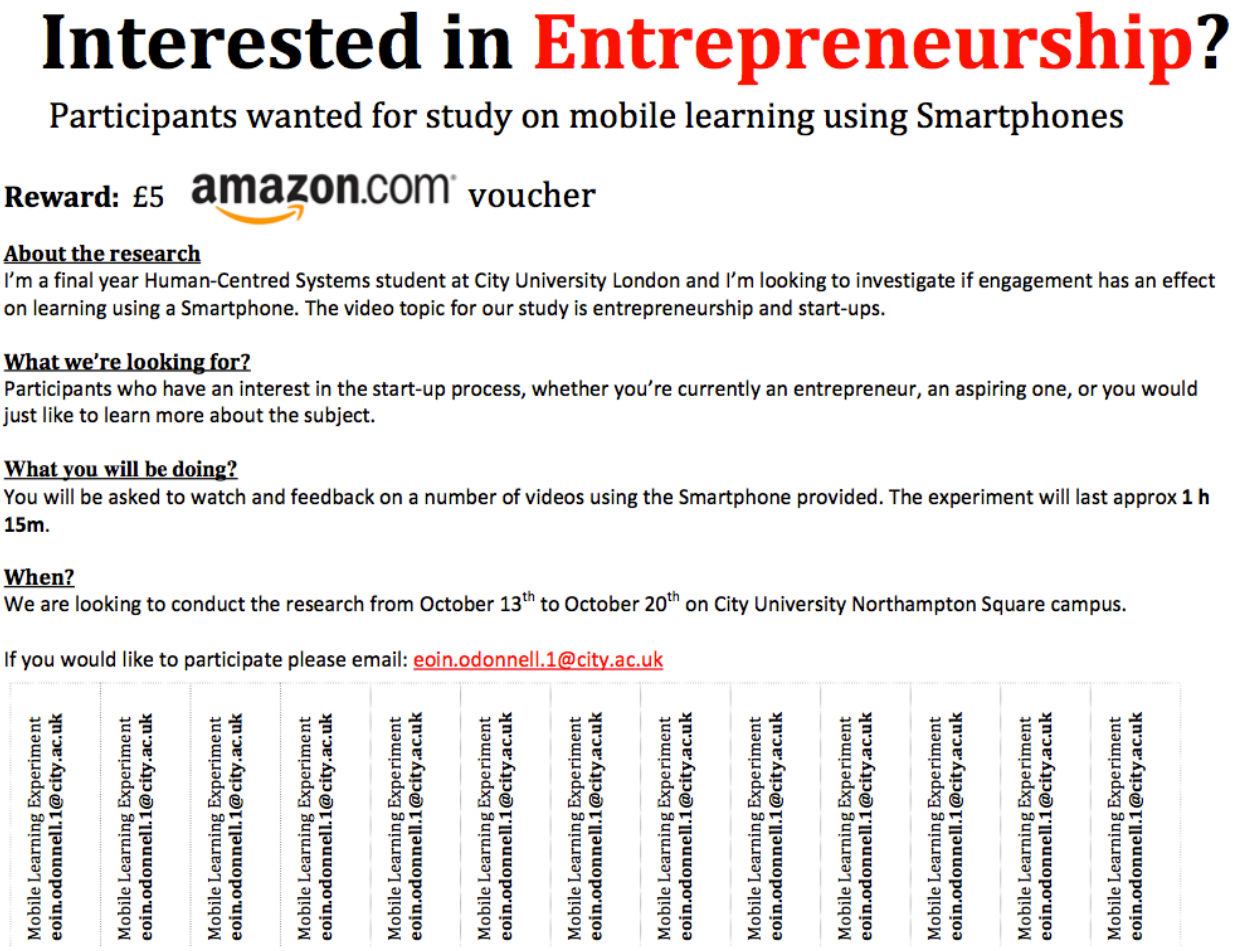

Interested in Entrepreneurship?
Participants wanted for study on mobile learning using Smartphones
Reward: £5 amazon.com voucher
About the research
I'm a final year Human-Centred Systems student at City University London and I'm looking to investigate if engagement has an effect on learning using a Smartphone. The video topic for our study is entrepreneurship and start-ups.
What we're looking for?
Participants who have an interest in the start-up process, whether you're currently an entrepreneur, an aspiring one, or you would just like to learn more about the subject.
What you will be doing?
You will be asked to watch and feedback on a number of videos using the Smartphone provided. The experiment will last approx 1 h 15m.
When?
We are looking to conduct the research from October 13th to October 20th on City University Northampton Square campus.
If you would like to participate please email: eoin.odonnell.1@city.ac.uk
Mobile Learning Experiment eoin.odonnell.1@city.ac.uk

Fig. 3.8

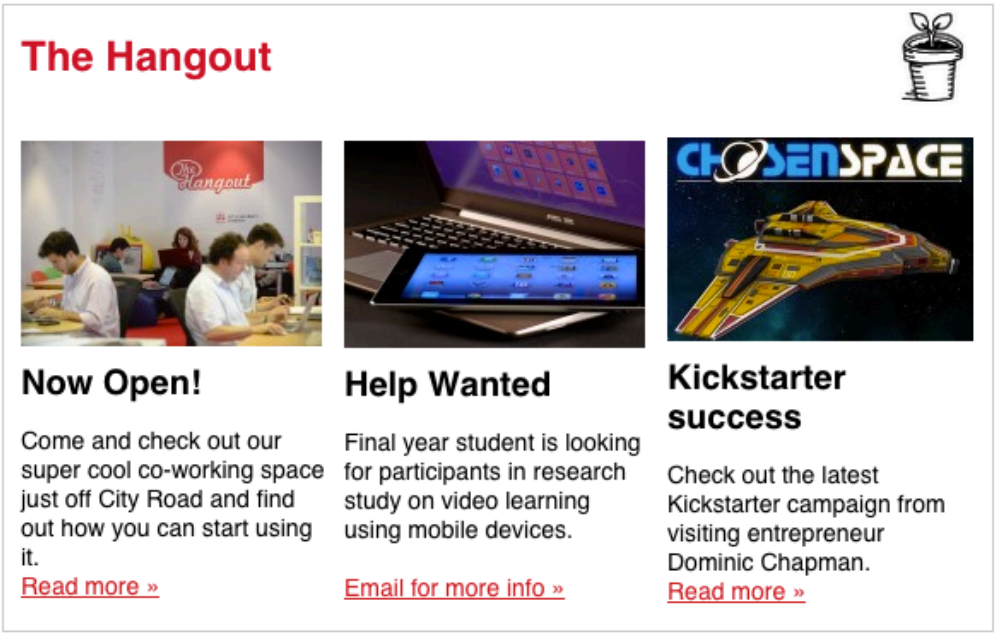


Fig.3.9

Those who passed the screening test and took part were rewarded a £5 Amazon voucher as a goodwill gesture.

Participants were from a variety of backgrounds that can be seen in Fig 3.10. In total 13 participants had studied to University undergraduate degree level, 7 to University masters level and 4 to doctoral level.

Gender

Male	Female
12	12

Age Range

18-21	22-34	33-45	45-54
3	18	3	1

Students	**Professionals**
15	9

Student Subjects:	Bio medical engineering, Law, Informatics, Requirements Engineering, Media studies and Business.
Professions:	Law, Marketing, Event Management,

	Academic Research, CEO of a tech company.

Fig. 3.10

3.6 Design and Development of Video Lessons

In order to investigate participant's use of video lessons on smartphones, it was decided that similar to a study conducted by Zhang et al (2006) the best way to achieve this was to build a mobile learning experience. Whereas Zhang et al (2008) worked with University lecturers to deliver course content through e-learning to students already registered for that module, for this study pre-existing content had to be sourced which would satisfy the presentation style and video duration requirements, as well as be suitable to the general population.

3.6.1 Lesson Styles and Duration

Whiteboard animated videos are growing in popularity due to recent successes from organisations such as 'The RSA', who have utilised whiteboard animations to help bring lectures from their live events come to life. Lectures on 'what motivates us' and 'changing education paradigms' have received over 12 million views each on YouTube. New software such as Videoscribe has made whiteboard animations more accessible to teachers who can now create a whiteboard style lesson with little design or technical knowledge. Teachers today are using these new technologies in the hope of increasing engagement levels amongst students. It was for this reason that this style was investigated.

The second presentation style of 'teacher with slides' was chosen as it is the most common form of teaching found in universities and conferences. This style is familiar to most and was seen as a good benchmark to compare whiteboard animations to. The choice of video durations of 3 minutes, 5 minutes and 10 minutes were influenced by previous literature (O'Hara et al, 2007; Södergård 2003; Finamore et al 2011).

Sourcing videos lessons that satisfied these requirements and were appealing to beginners proved difficult because it was difficult to find a teacher who had presented in both styles. Eventually a teacher was found but a workaround had to be created for video durations. For the longer lessons video editing software Camtasia was used to cut and combine smaller videos to create a full lesson. These smaller videos were in context with one another, and the final edit had the appearance of one stand-alone class.

3.6.2 Subject Matter

When choosing teaching content a subject was chosen that was considered appealing to a wide audience, which each participant could relate to regardless of their interests. Entrepreneurialism is currently a popular subject and one, which generates great excitement from audiences. As a subject it can be applied to a variety of different industries, and as the principles of building a start-up are generally the same, all participants with an interest in the subject could potentially

benefit. The subject was chosen at a beginners level to give greater access to the general population. This could apply to users from different backgrounds, who had different motivations, and varying levels of experience with technology.

3.6.3 Instructor

For the study it was important that the same instructor was used to deliver both presentation styles. This was to avoid participant bias towards one particular teacher, which could affect their preference towards a particular presentation style. Also it was vital that the level of teaching was consistent for both video styles and was delivered in the same enthusiastic manner.

A teacher by the name of Steve Blank was discovered. He has delivered online entrepreneurial lessons using both presentation styles. Blank has over 30 years of start-up experience having worked with 8 start-up companies. Further he has published 4 books on the subject, and is recognised as developing the Lean Start-up movement. Blank's work was also chosen as he delivers his teachings with great passion and enthusiasm, which would be engaging and appropriate for the study's participants.

3.7 Framework For Data Analysis

3.7.1 Quantitative Analysis

For the post-lesson exam a clear correction criteria was put in place and scores were awarded to participants for correct facts recalled from each video lesson. This data was then recorded in a Microsoft Excel spreadsheet. Participant's IEQ and SIQ scores were also recorded in Microsoft Excel for all six video lessons. Other quantitative data recorded was the time taken to complete each post-lesson exam.

This data was transferred to SPSS 22 for further analysis. SPSS was used to produce descriptive statistics for IEQ, SIQ and post-lesson exam scores. These results gave an initial indication on which videos lessons participants scored higher for both immersion and learning. The descriptive statistics gave a good overview of results, however, further analysis was needed to achieve the study's objectives. After running tests of normality such as the Shapiro Wilks test and plotting results in histograms and q-plots, it was found that the SIQ and post-lesson exam results were not normally distributed. This may have been due to the small sample size. Immersion experience questionnaire results were seen to be normally distributed, however, as part of the study was to compare these results to both SIQ and exam results, it was decided for reliability purposes to treat all data as non-parametric.

The following test were ran using SPSS:

- A Friedman's analysis of variance test to determine whether there was significant difference in IEQ scores for all six video conditions

- Post hoc paired Wilcoxon tests on IEQ results to explore the differences found from the Friedman's analysis
- A Friedman's analysis of variance test for SIQ scores to search for significant difference for all the six conditions
- Post hoc paired Wilcoxon tests on the SIQ data to investigate differences found in the Friedman's test
- A Spearmans rho to test for a correlation between IEQ and SIQ scores
- A Friedman's analysis of variance test for post-lesson exam scores to investigate differences in results across all the six conditions
- Further paired Wilcoxon tests on exam scores to investigate differences uncovered from the Friedman's test
- A Spearman's rho to establish a correlation between exam scores and IEQ results
- A Spearman's rho to establish a correlation between exam scores and SIQ results
- A two-factor ANOVA for IEQ, SIQ and exam scores for all six conditions
- A Friedman's analysis of variance test for the five immersion factors

For all the above analysis significance was found at $p < .05$. For this study the Bonferroni adjustment was considered for the study's post-hoc Wilcoxon tests, however, the adjustment is seen to be quite conservative which is a disadvantage of its use. As 6 independent variables were tested in the study, this amounted to 15 pairs which would have reduced the chances of significance greatly (0.05/15 = .0033). As this study is the first of its kind whose purpose is to pose new questions associated with mobile video learning, it is hoped that this study will encourage future research that could be investigated more stringently. This topic is discussed in more detail in Chapter 4 (Results and Discussion).

In the analysis an ANOVA with two within-participant factors was conducted on IEQ, SIQ and post-lessons exam scores. It is understood that to run an ANOVA data must be drawn from a normally distributed population. However, in this case no equivalent test was found for non-parametric data, therefore an ANOVA was used. Considering this it must be notified that these results should be treated with a degree of caution. A number of interesting results were uncovered from our participant study, which is discussed in more detail later in this study.

3.7.2 Qualitative Analysis

Data from participant's background questionnaires were documented in Microsoft Excel. Interviews were audio recorded and later transcribed using Microsoft Word (**Appendix P**). Common themes were identified from both in relation to video length and presentation preference. These were used to help discuss the quantitative results from SPSS.

3.8 Experimental Procedure

The research was conducted over a 4-week period and participants were seen on a one-to-one basis. After participant screening a maximum of four participants were seen per day. From 25

respondents that partook in the study, one was treated as a pilot study. This helped establish a reliable framework for the overall research.

Participant studies were either conducted in a private meeting room in City University library or the participant's home. The study was split into three phases lasting between one-hour twenty and one-hour forty minutes.

Phase 1: Participant greeting, experimental overview document, informed consent, background questionnaire, study discussion and introduction to the mobile app.

On arrival participants were thanked for their participation in the study and were made comfortable. Participants were first provided with an overview of the experiment to read. After completion they then read and signed the informed consent form provided. An extra copy of the consent form signed by both the participant and researcher was provided for the participant to keep. They were also given a copy of the experiment overview that included the researcher's contact details.

First participants were asked to complete a background questionnaire (**Appendix J**). This included information on:

- Gender
- Age
- Occupation
- Level of education
- Experience of technology
- Smartphone usage
- Mobile video learning experience
- Attitude towards mobile video learning
- Experience with entrepreneurship

After a brief discussion on how the experiment would work and that it was being recorded using the Macbook Pro webcam, participants were given an iPhone 5S. Prior to the study participants were advised to bring their own headphones for comfort, but if they failed to do so they were presented with a spare set. Participants were then shown how to use the mobile app for the video lessons. After the completion of each video lesson they were asked to inform the researcher. Prior to the experiment the participant's seat was adjusted so the screen of the Smartphone was facing the Macbook webcam as seen in Fig. 3.10. Phase one of the study usually lasted from 5 to 10 minutes.

Fig. 3.11

Phase 2: Experiment (including completion of IEQ, SIQ and exam after each video)

Participants were given the video lessons in a pre-determined random order. On completion of each, the smartphone and headphones were handed back to the researcher. Their chair was then rotated so they were sitting comfortably at the Macbook pro. They were then presented with an open Microsoft Word document. At the top of the page was the question:

If you were to explain what you have learned from that video to somebody else, what would you tell them?

(Please use bullet points and sentences for each separate point).

The document already included a bullet point so participants did not waste time using identifying the toolbar. Participants were read the question aloud and then were informed that they had either 2 minutes, 3 minutes 20 seconds, or 6 minutes 40 seconds, to answer dependent on the video they had previously watched. They were also told that if they were finished within the allocated timeframe to inform the researcher and the next step of the study could take place. When they began the stopwatch was started.

After the completion of the exam participants were presented with the 31-question IEQ and were asked to complete it for the video they had just experienced. After completion of the questionnaire the participant's chair was repositioned so the smartphone screen was facing the webcam. They were presented with the smartphone again with the following video lesson prepared for viewing.

This routine was then conducted another 5 times for each video lesson. In total 36 minutes of video content was viewed. On average phase two of the study would usually last between 70 and 95 minutes.

Phase 3: Post-study semi-structured interview

After the completion of the experiment a semi-structured interview was given that lasted approximately five minutes. This was to gain insight into the participant's experience, to find what they liked and disliked, and to help explain why they performed the way they did. They questions asked were:

- Did you have a preference to a particular style of video?
- Do you think that you learned more from that style?
- Do you feel that the lengths of the video lessons had an effect on your learning?
- Did watching them on a mobile phone influence your ability to learn?
- What does it mean to you to be immersed in a video class?
- Have you anything further to add?

Participants were asked about their preference of presentation style and whether they thought they learned more from that style. This last was to investigate if participants were swayed by the aesthetics of the whiteboard videos, when in fact the 'teacher with slides' style may have been more effective. The following questions investigated participant's attitudes towards video duration, their opinion regarding watching a video lesson on a smartphone and whether the felt one style suited the Smartphone better than the other.

After completion of the study participants were informed where they could find the video lessons online if they were interested and were given a £5 Amazon voucher. The interviews were audio recorded, and a backup recording could also be referred to using the webcam recording. These can be found on the accompanying USB stick.

3.8.1 Experimental Setting

The study took place in a similar setting for each participant. It was important that noise levels were low, surrounding distractions were kept to a minimum and participants felt comfortable in the space. To ensure that reliable data was gathered, it was paramount that each participant had a similar experience.

It was tempting to conduct the participant studies in real world mobile environments, however this was dismissed for a number of reasons. Firstly the logistics would have been extremely difficult. The researcher would need to accompany the participant on whatever mode of transport they used. Secondly, it was not realistic to expect that participants would be able to complete the study on their own. Thirdly, different mobile surroundings present different obstacles, therefore it would be impossible to know and very unlikely that participants would have the same experience. Fourthly, participants needed to be tested after each video lesson using the immersion questionnaire and post-lesson exam. This would have been extremely difficult to achieve in a public environment. Finally, a controlled lab setting was also considered where public distractions could be controlled and manipulated but due to the intensity of the teaching content and the examination process it was decided that this would not be appropriate. Suggestions for further research are discussed in section 5.5.

3.8.2 Equipment

To avoid technical difficulties such as low battery or problems with software, participants were provided with an iPhone 5S preloaded with the learning app. The iPhone 5S was chosen (Fig. 3.12), as it is a smartphone that is commonly used, which a good-sized screen of 6.7 square inches and a powerful operating system. The phone was used later as an audio recorder to record post-lesson interviews.

A Macbook pro was used with Microsoft Word to record participant's post-lesson examination. The Macbook's webcam and Photo Booth were used to visually record the study. This webcam recording was useful to refer to at later stages of analysis if there were parts of the iPhone recording that were inaudible. Webcam recordings were explored to identify participant's physical habits when watching the lesson such as boredom, fatigue or physical discomfort. Each participant's mannerisms were very different and the only common action found was for the longer ten-minute videos, where a number of participants finger tapped the display screen to see how long was left.

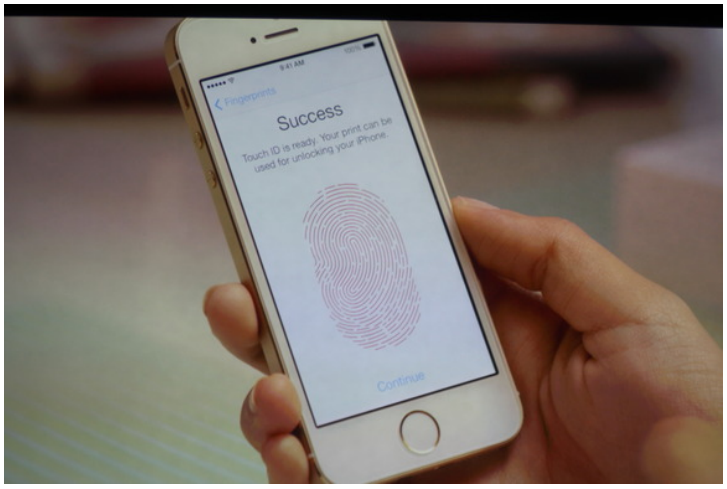


Fig. 3.11 iPhone 5S

3.8.3 App Prototype

An app prototype was developed for this study built using Xcode. It was important that throughout the study participants were able to move seamlessly from one video lesson to the other, and the app interface enabled this.

The mobile app also had the capability to download video lessons to the mobile device. This helped prevent technical problems such as loss of Internet connection or slow video buffering speeds affect the study. The original video lesson files were stored in the cloud using Amazon S3.

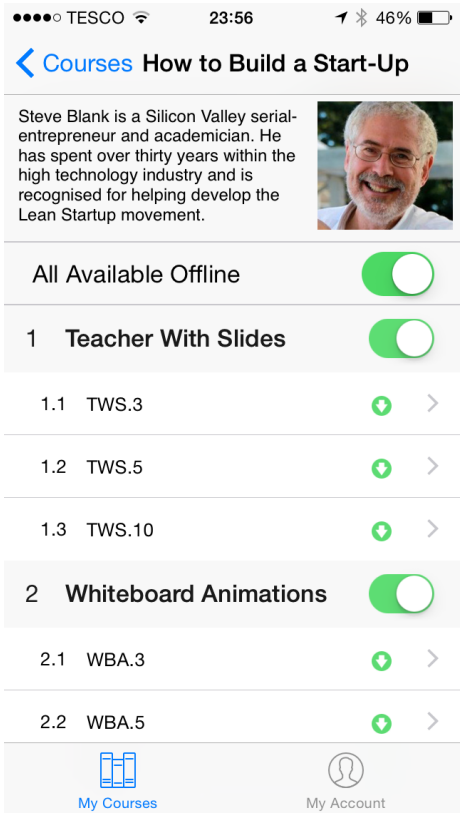


Fig. 3.12 iPhone learning app developed

3.8.4 Session Scripts and Materials

The researcher followed a session script during the study to provide a clear point of reference throughout the session and to ensure that no elements of the study were overseen (**Appendix I)**.

Other materials include:

- Participant information sheet (**Appendix G**)
- Adult consent form (**Appendix H**)
- Background questionnaire (**Appendix J**)
- Immersion experience questionnaire (**Appendix L**); and
- Post-lesson exam template (**Appendix K**).

Care was taken to ensure that participants were not influenced by the way questions were worded or phrased.

3.8.5 Ethics

All data obtained was handled ethically throughout the study. This research did not pose any risk to the participants and after a full explanation of the project and its objectives using the participant information sheet, consent was gained from each individual. All participants were over the age of 18 and their anonymity has been protected.

Participant's personal information will be held in the utmost of confidence and destroyed after the project is submitted. During the study session the participants were treated fairly, made comfortable and informed that they could stop the study session at any point in time if they chose. There were no ethical issues in this study that violated City University's research ethics policy.

3.9 Lessons Learned From the Pilot Session

Due to the experimental nature of the design a pilot study was necessary to test:

- Participants' understanding of the lesson content
- Total time taken for the testing session
- Time taken to complete the IEQ
- Participants' understanding of the IEQ questions
- The clarity of the examination process
- The reliability of the app
- Any other issues

Valuable information was learned from the pilot session. This resulted in changes being made to the final participant study. According to the pilot participant the content for each lesson was understandable, however, they thought that viewers would need to be either very interested in the subject matter or come for a business background, especially considering the longer and more challenging videos. This informed the type of participants that were recruited in the later study.

As the IEQ contained 31-questions, it was feared that this may have been too much for participants to complete, especially as it had to be completed 6 times throughout the study. However it was found that the questionnaire worked well. The pilot participant took approximately 4 minutes to complete the questionnaire the first time, as they were reading and gaining an understanding of each question. The time to complete the remaining IEQ's was much faster, taking approximately 2 minutes each.

The participant found the following questions from the IEQ confusing:

- *11. To what extent did you feel that you were interacting with the video environment?*
- *16. To what extent did you feel as though you were moving through the class according to your own will?*

As the IEQ was created to measure video games, it is understandable why these questions may not have applied to video learning. Video gaming is an interactive process requiring user participation. In comparison there is very limited interactivity in pre-recorded lessons. These questions were not omitted from the study, however future participants were advised that there might be some questions that they might feel did not apply, but to answer them to the best of their ability.

After assessing the pilot study changes were made to the examination process. In the pilot study the participant was asked to take each exam, after they had completed the 31-question IEQ. This proved difficult for the participant as the questionnaire distracted their focus from the lesson content. Due to this cognitive strain, the participant found it difficult to recall what they had learned. For future sessions the ordering was reversed, whereby participants would take the exam before completing the IEQ.

Clarification was also needed for the examination instructions. For the pilot study the participant was asked to write on a sheet of paper what they 'remembered' from the lesson. This should have been made clearer as the participant gave feedback such as "it was very long" and "there were boxes in the background", rather than relaying the content from the lesson. The participant also listed one-word answers that were difficult to correct and were open to interpretation. Finally some of the handwriting was difficult to decipher.

The solution was to provide future participants with a laptop and ask them to type their exam answers. To provide clarity on what was expected in the exam, the task was written at the top of each separate Word document page. The use of the word 'learned' was much clearer than the word 'remembered'.

From the pilot participant feedback, wording adjustments were made to the background questionnaire and questions were changed to improve the participant's understanding. Questions were also adjusted for the post-study interview. The participant progressed through the pilot session at a good pace and the session lasted 1 hour and 26 minutes including the post study interview. This was below the 1 hour 30 minutes as expected. There were no technical problems and the app performed reliably. This was mainly due to its ability to download (rather than stream) videos to the smartphone.

3.10 Limitations and Potential Problems

This research was conducted in an ethical and professional manner, however, with experimental research there is always the possibly of problems or limitations arising from the study.

The results uncovered from this research should not be generalised and applied to all subjects taught on smartphone devices. A similar study could be conducted with same number of participants, but teaching a different subject in a different environmental setting. The results could be very different to the results uncovered in this study. This is entirely plausible, however in this

study the researcher has done his utmost to ensure that theoretically sound research techniques were used. For example the SIQ was used to improve the reliability of the IEQ data. In this study a highly structured and detailed approach was put in place to improve reliability using data collection techniques that have been validated in the community. Each element of the participant research was conducted to a high standard as if the project supervisor was present.

There may be a question of reliability of this study due to its experimental nature. To improve the study's reliability subjective data such as interviews and questionnaires were combined with quantitative measures. In total 80% of participants did not know the researcher prior to the study and all participants had little experience of mobile video learning. As everything was new, participant's objectivity did not come into question. Also participants were made aware that the purpose of the study was to test content and not the app created by the researcher. As a result honest feedback was given.

It may be the case that extraneous factors may have influenced participants, which could affect their immersive experience. Factors such as participant's mood may have influenced the amount of effort they put into the study. Likewise users may have had their own preconceptions prior to attending the session. Examples of these may be that they don't like watching videos on smartphones at all, or they may think that whiteboard animations are really impressive and they watch them all the time. The researcher unfortunately could not influence these views, however as measures were taken of immersion and exam performance this would hopefully reveal the participants' true thoughts.

It may be questionable if both presentation styles are of the same video quality and are to the same teaching level. To ensure this, all editing in the creation of the video lessons was done to the best of the researcher's ability. Furthermore, opinion from third parties was obtained on the level of teaching content for each video. To improve the reliability of the lesson content the same instructor was used for both presentation styles. From the pilot test conducted, no significant difference in levels of teaching content between the two styles was identified.

It may be considered that due to the overall hypothesis of this study, that the experiment effect may have influenced the participants' responses. Care was taken to be as unbiased as possible throughout the study. Besides providing participants with instructions on how the study would work and how the app is used, the researcher spoke very little. In other documentation questions asked in the background questionnaire and in the post-lesson interview were done so objectively. Lastly it was ensured that similar environmental surroundings were used for each participant that involved little outside influence or distraction. It was important that each participant had the same learning experience and the researcher tried to facilitate this by pre-booking private meeting rooms.

The following chapter 'Results and Discussion' highlights objectives set in the context of this research and analyses the results uncovered in detail.

4. Results and Discussion

4.1 Introduction

This chapter reveals the results of the empirical research study described in Chapter 3 (Research Methods). The research concentrates on 24 participants who each watched 6 videos on the subject "How to Build a Start-Up" using a Smartphone. The characteristics of engaging educational video content using smartphone devices are explored, as is the effect that this engagement has on participant's learning.

This experimental research is approached in a highly structured manner. All participants' IEQ, SIQ and exam scores can be found on the accompanying USB stick for this study. The outputs from SPSS can be found in **Appendix Q** and transcripts from participant post-lesson interviews in **Appendix P**.

As discussed in Chapter 3 (Research Methods) for this study the Bonferroni adjustment was considered for all data analysis, but after consideration It was decided that I would not be used. The reason for this was the adjustment is quite conservative, and as this study has 6 independent variables (15 pairs), it would have reduced the chances of significance greatly (0.05/15 = .0033).

From hereafter whiteboard animated videos lessons will be referred to as WBA, and 'teacher with slides' lessons referred to as TWS.

4.2 Investigating Video Characteristics and Immersion

4.2.1 Immersion Experience Questionnaire (IEQ)

A Shapiro-Wilk's test ($p > .05$) and a visual inspection of their histograms, normal Q-Q plots and box plots showed that IEQ scores were normally distributed for all videos (**Appendix Q**). Although these results were seen to be normally distributed, it was decided to treat them as non-parametric. The reason for this is that the distribution of later data, for the SIQ and post-lesson exams, turned out to be non-parametric. As a fundamental part of this analysis is to compare IEQ, SIQ and exam scores, treating all data as non-parametric makes sense as it is seen to produce more reliable results.

4.2.2 Participants IEQ Findings

The mean IEQ score for all six videos was 102.97 from a maximum score of 155. IEQ scores for all six videos can be seen in Fig. 4.1. This shows that participants IEQ scores were highest for the 3-minute whiteboard animated video WBA.3 ($M = 112.17$, $SD = 15.84$), and lowest for the 10-minute teacher with slides video TWS.10 ($M = 90.83$, $SD = 20.95$). From observation of both presentation styles it can be seen that as the duration of video lessons increase, participants IEQ scores decrease.

IEQ	N	Mean	Standard Deviation	95% Confidence Interval Mean	
				Lower	Upper
All Conditions	144	102.97	18.809	99.73	106.01
TWS.3	24	107.25	18.63	99.75	114.67
TWS.5	24	102.96	17.46	96.13	110.29
TWS.10	24	90.83	20.95	82.50	99.50
WBA.3	24	112.17	15.84	105.63	118.37
WBA.5	24	103.75	17.27	96.21	110.46
WBA.10	24	100.87	17.13	94.17	107.25

Fig 4.1 IEQ scores, per video

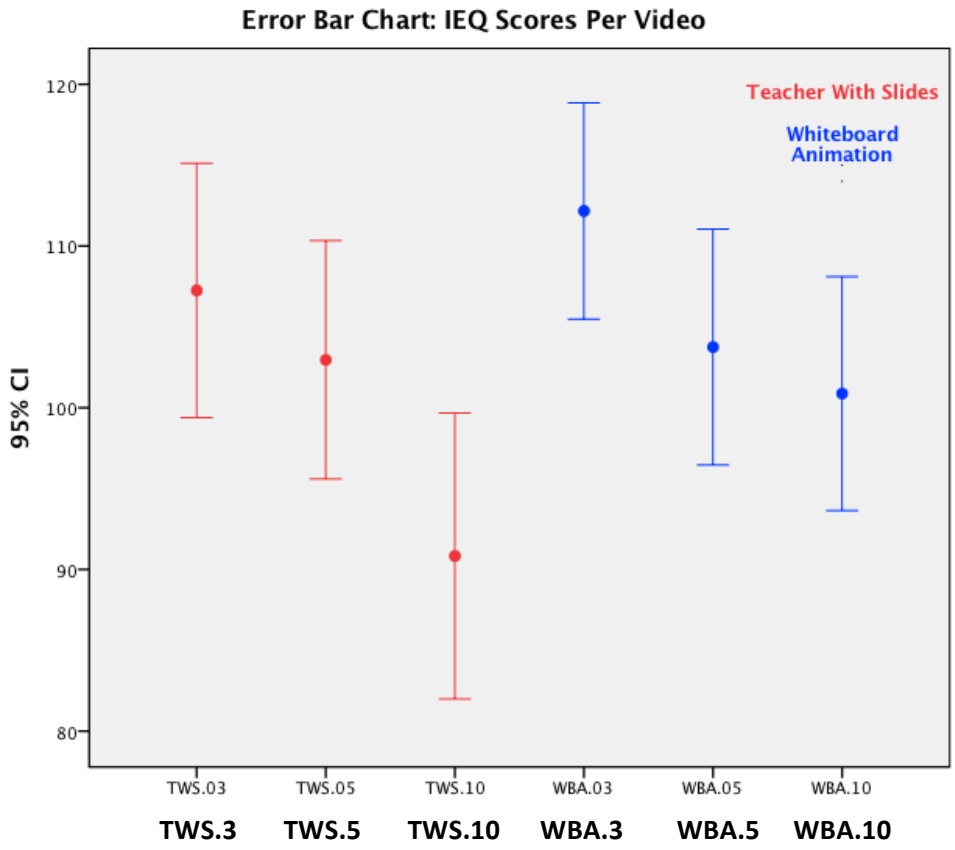


Fig 4.2 IEQ scores and confidence intervals, per video

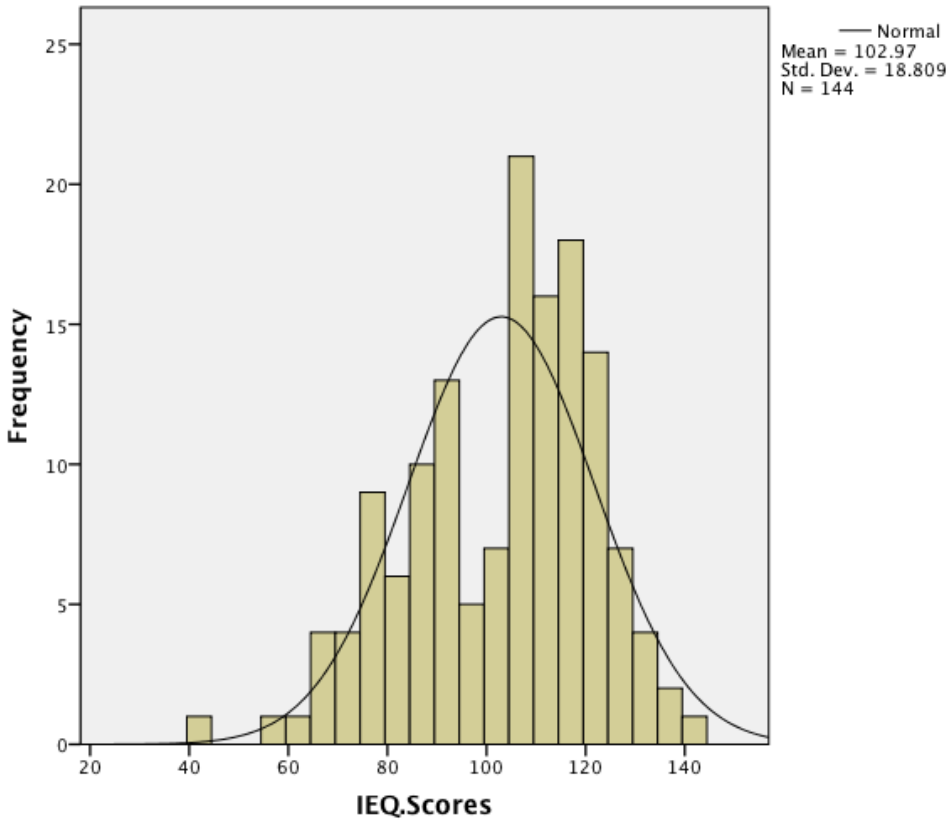


Fig 4.3 Frequency Distribution of IEQ scores for all videos (N=144)

IEQ Box Plots

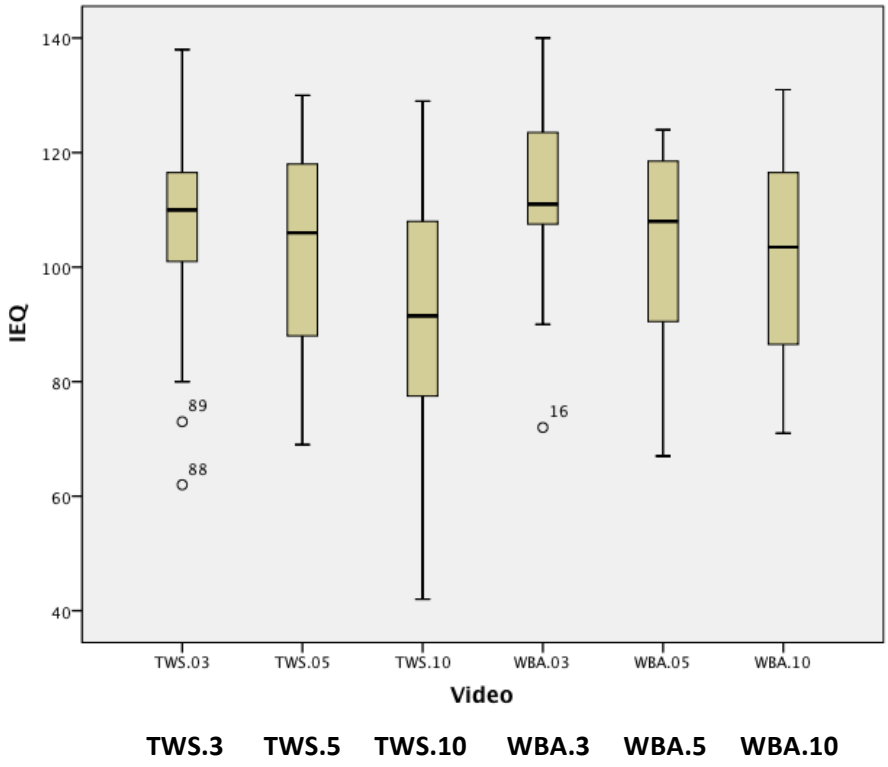


Fig 4.4 IEQ Box Plots, per video

From the IEQ box plots in Fig. 4.4 three extreme scores can be seen. As the mean is sensitive to extreme scores and IEQ data is being treated as non-parametric, median scores will be studied in more detail (Fig. 4.5).

From these box plots there appears to be a significant difference between videos WBA.3 (Med = 110.00) and WBA.5 (Med = 108.00), and also between videos WBA.3 (Med = 110.00) and WBA.10 (Med = 103.50). However from visual observation no significant difference is seen between videos WBA.5 (Med = 108.00) and WBA.10 (Med = 103.50) as there is overlap in their h-spread's.

This box plot suggests that for whiteboard animated videos, there appears to be a cut off point between 3-minutes and 5-minutes where if exceeded, immersion drops significantly. It also suggests that once this point is past, increasing the length of video has little affect on participant's immersion. This supports the theory that mobile videos are not associated with deep learning experiences (Peng et al. in Melhuish and Falloon: 2010:9). Teachers can use this as guideline that when creating whiteboard-animated videos content, try keep to keep video duration as short as possible.

The findings for 'teacher with slides' style videos are vey different. It seems there is little difference between videos TWS.3 (Med = 110.00) and TWS.5 (Med = 106.00), however there is

significant difference between videos TWS.5 (Med = 106.00) and TWS.10 (Med = 91.50), and between TWS.3 (Med = 100.00) and TWS.10 (Med = 91.50). This is an interesting development that suggests there may be an interaction effect between style and video length, but that this effect matters differently for each presentation style. This will be explored later in the analysis.

The result shows that although a 3-minute WBA video is a much greater immersive experience than a 3-minute TWS video, when exceeded immersion levels drops significantly. Alternatively for the TWS style immersion levels remain steady up to 5 minutes.

IEQ	N	Median	Std. Error	95% Confidence Interval	
				Lower	Upper
All Conditions	144	108.00	1.48	104.00	110.00
TWS.3	24	110.00	2.88	105.08	116.00
TWS.5	24	106.00	6.14	90.00	116.00
TWS.10	24	91.50	5.92	81.00	106.00
WBA.3	24	111.00	3.10	109.13	122.00
WBA.5	24	108.00	5.71	92.51	116.50
WBA.10	24	103.50	6.05	90.00	110.99

Fig 4.5 IEQ median scores, per video

4.2.3 A 2nd Measure of Immersion: Single Immersion Question (SIQ)

A Shapiro-Wilk's test (p>.05) and a visual inspection of their histograms, normal Q-Q plots and box plots showed that single immersion question (SIQ) scores were not normally distributed for all videos. The null hypothesis was that data was normally distributed, however it was rejected for videos TWS.3, WBA.3 and WBA.10 as their p-values were below 0.05 (**Appendix Q**). As data is not normally distributed the SIQ will be treated as non-parametric.

4.2.4 Participants SIQ Findings

The frequency distribution scores for the SIQ can be seen in Fig. 4.6 for all 144 videos. It can be seen that the distribution is somewhat negatively skewed but this was expected, as the data is non-parametric.

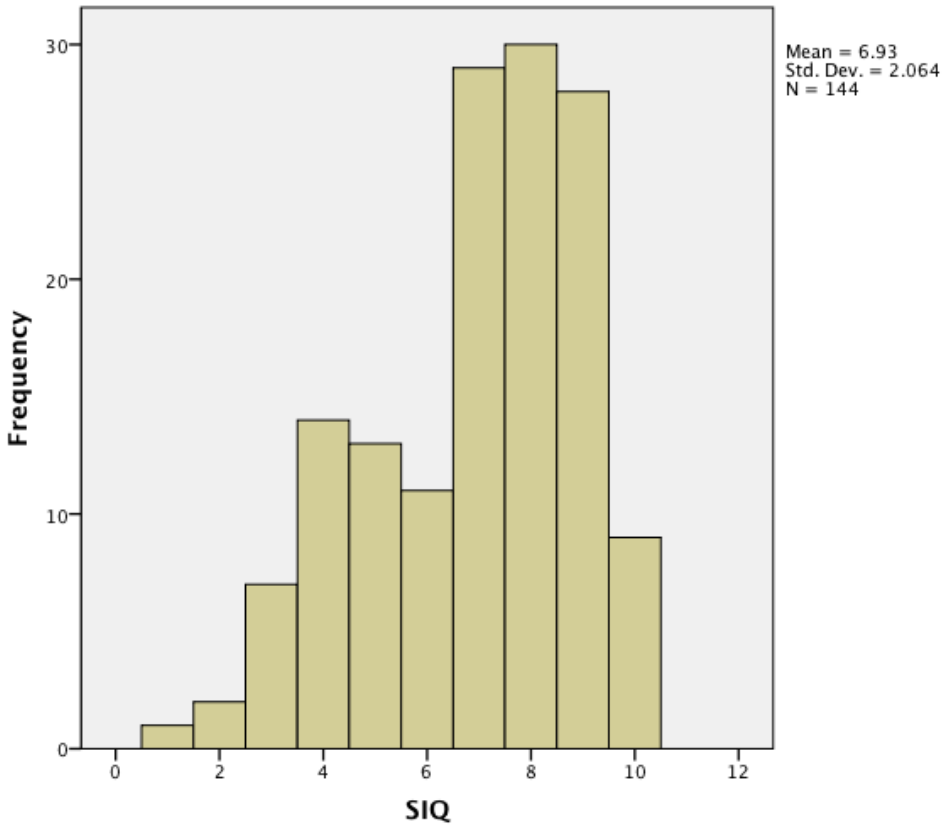


Fig. 4.6 Frequency distribution, SIQ scores for all videos (N=144)

The means SIQ score for all 144 videos viewed was 6.93 (Fig. 4.7). This was from a maximum score of 10. Similar to the IEQ scores, participants SIQ scores were highest for the 3-minute whiteboard video WBA.3 (M = 7.96, SD = 1.76) and lowest for the 10-minute teacher with slides video TWS.10 (M = 5.54, SD = 2.36). Also similarly to the IEQ scores for each presentation styles as video durations increase, SIQ scores decrease. Both results suggest that video duration is an important characteristic that affects participant's immersion levels.

SIQ	N	Mean	Standard Deviation	95% Confidence Interval	
				Lower	Upper
All Conditions	144	6.93	2.06	6.57	7.25
TWS.3	24	7.25	1.89	6.58	7.92
TWS.5	24	6.96	1.97	6.25	7.75
TWS.10	24	5.54	2.36	4.63	6.50
WBA.3	24	7.96	1.76	7.25	8.58

WBA.5	24	7.29	1.76	6.54	7.96
WBA.10	24	6.58	1.95	5.83	7.29

Fig. 4.7 Single immersion question scores, per video

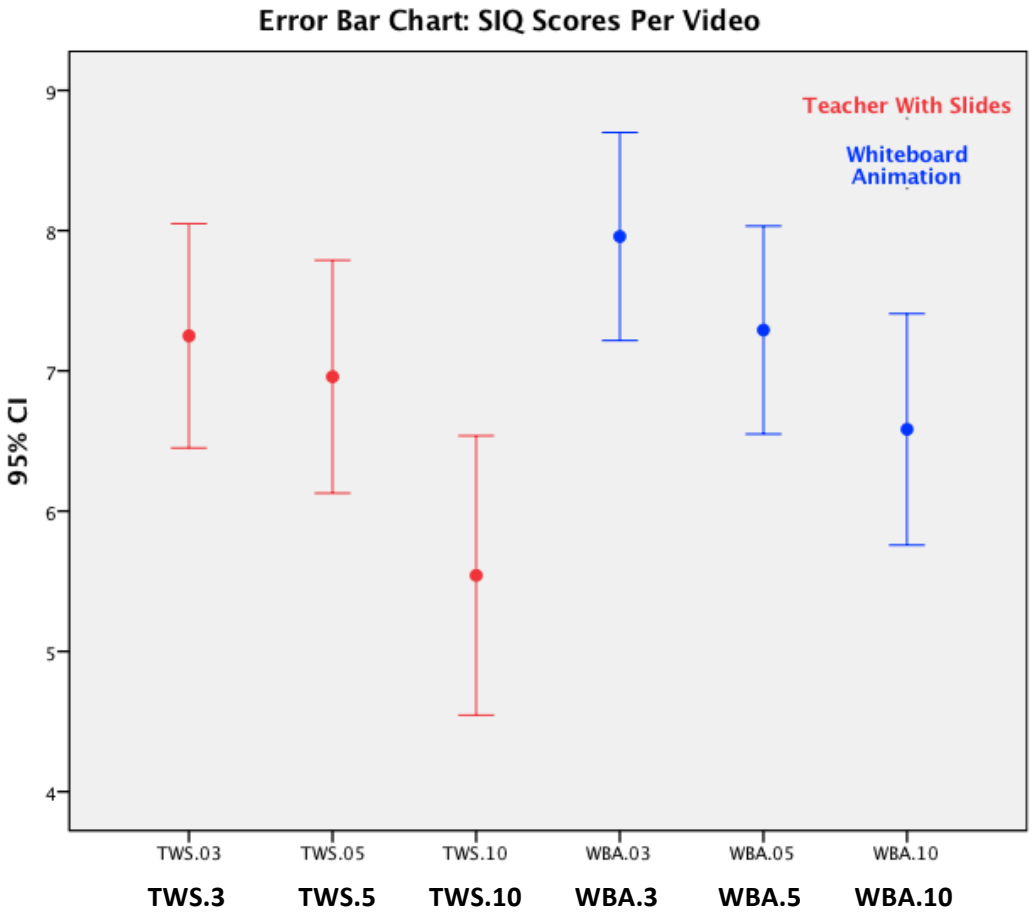


Fig 4.8 Error bar char of SIQ scores, per video

Although the similarly of SIQ and IEQ results are interesting, as the distribution of the SIQ data is skewed caution is taken regarding using the mean as a measure of central tendency. This is because scores on the extended tail of the distribution will alter mean scores. With this in median scores will be explored.

SIQ	N	Median	Std. Error	95% Confidence Interval	
				Lower	Upper
All Conditions	144	7.00	.40	7.00	8.00
TWS.3	24	7.50	.471	7.00	8.00
TWS.5	24	7.00	.443	6.00	8.00
TWS.10	24	6.00	1.12	4.00	7.00
WBA.3	24	9.00	.611	7.00	9.00
WBA.5	24	8.00	.472	7.00	8.49
WBA.10	24	7.00	.854	5.00	8.00

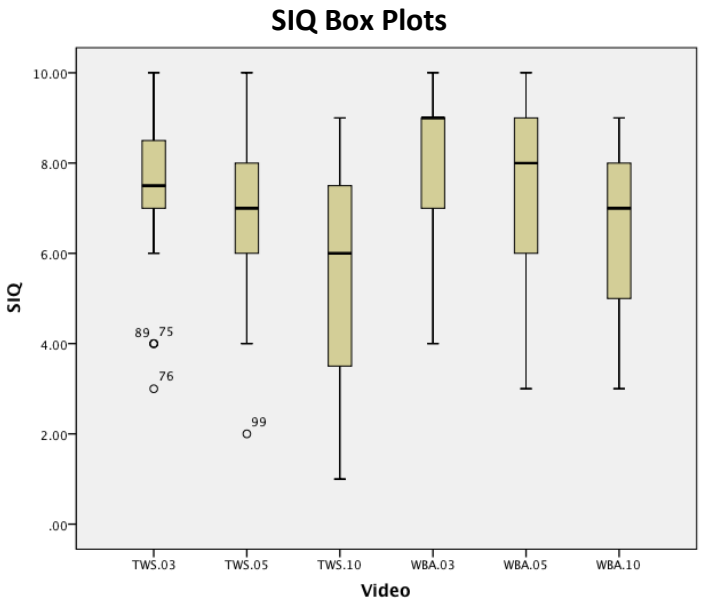
Fig 4.9 SIQ median scores, per video

The SIQ scores show a very similar pattern to the IEQ. The highest scoring video was the 3-minute whiteboard animation WBA.3 (Med = 9.00, STE = .638) and the lowest scoring video was the 10-minute 'teacher with slides' video TWS.10 (Med = 6.00, STE = 1.08). Again there was a steady deterioration in SIQ median scores for each style as video duration increased.

4.2.5 IEQ and SIQ Analysis

Box plots were compared for SIQ and IEQ scores to see if there was a similar visual pattern in immersion results. In Fig. 4.10 it can be seen that SIQ and IEQ box plots were very similar, however there were some inconsistencies. First, for SIQ whiteboard results it appears there is no significant difference between videos WBA.3 (Med = 9.00. STE = .638) and WBA.5 (Med = 8.00, STE = .509). This is contrary to IEQ results where significant difference appears. Although still relatively similar for SIQ scores there appears to be more of a difference between videos WBA.5 (Med = 8.00, STE = .509) and WBA.10 (Med = 7.00, STE = .889) when compared to the IEQ.

For 'teacher with slides' presentation style, videos TWS.3 (Med = 7.50, STE = .478) and TWS.5 (Med = 7.00, STE = .456) show no significant difference, however there is less overlap in their h-spread's when compared to their IEQ scores. Similar to the IEQ significant difference is observed between videos TWS.5 (Med = 7.00, STE = .456) and TWS.10 (Med = 6.00, STE = 1.08).



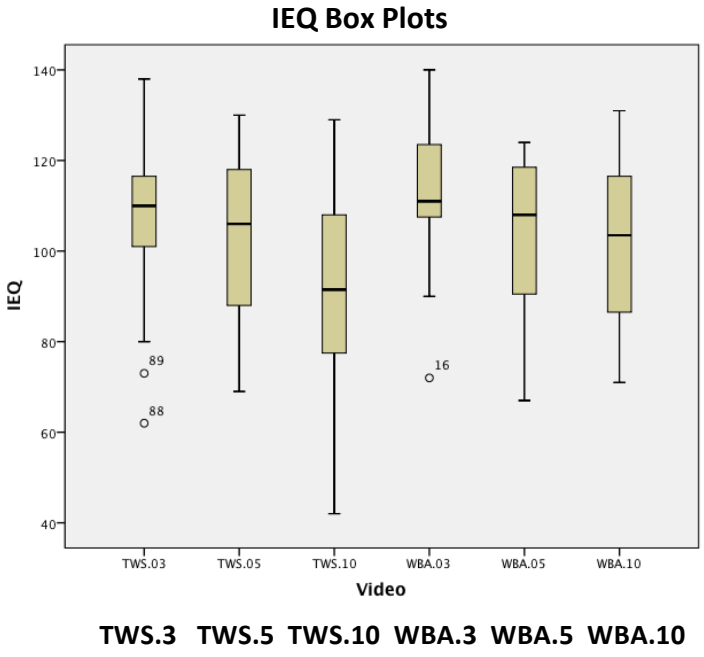


Fig 4.10 SIQ median scores, per video (N=144)

The inconsistency in results could be for a number of reasons. For the TWS style very similar results are seen for IEQ and SIQ box plots. Whereas for whiteboard animations SIQ scores for

WBA.3 and WBA.5 show more similarity. It is not clear why participants would score higher SIQ scores for WBA.5 in comparison to their IEQ scores. It may be because the 31 question IEQ is a much more refined measure of immersion. As the IEQ explores immersion at a deeper level, differences in immersion may become more apparent.

Also as the range for the IEQ is from 1-155 compared to 1-10 for the SIQ, one would naturally expect more overlap in box plot results for the SIQ. Perhaps the SIQ can only be used as a top-level indication off whether a video is immersive or not, whereas the IEQ provides a more thorough and accurate measure. Previous studies that have measured the SIQ have only done so to confirm IEQ scores. (Jennet et al. 2008; Jennett, 2010). These results suggest that the SIQ may not be an accurate enough measure of immersion to be used alone.

4.2.6 Relationship between IEQ and SIQ

Analysis was conducted to explore if a correlation could be found betwee IEQ and SIQ scores, in relation to mobile video learning. Previous research indicates that this is true for video gaming (Jennett et al.); however it has yet to be proved for smartphone video lessons.

As data was non-parametric, a Spearman's rho test was used to compare each participant's IEQ results with their SIQ scores. In total 144 pairs of scores were investigated. The correlation between IEQ scores and SIQ scores was .835. Such a strong correlation has a small chance of arising from sampling error ($p < 0.001$) assuming the null hypothesis to be true. In conclusion the relationship between IEQ and SIQ was found to be positively and strongly related ($r = .835$, $p < 0.001$). Thus as participants IEQ scores rise, so do their SIQ scores **(Appendix Q)**. Figure 4.11 shows the correlation between participants IEQ scores and SIQ scores for all conditions. It can be seen from the regression line that there is a positive linear relationship.

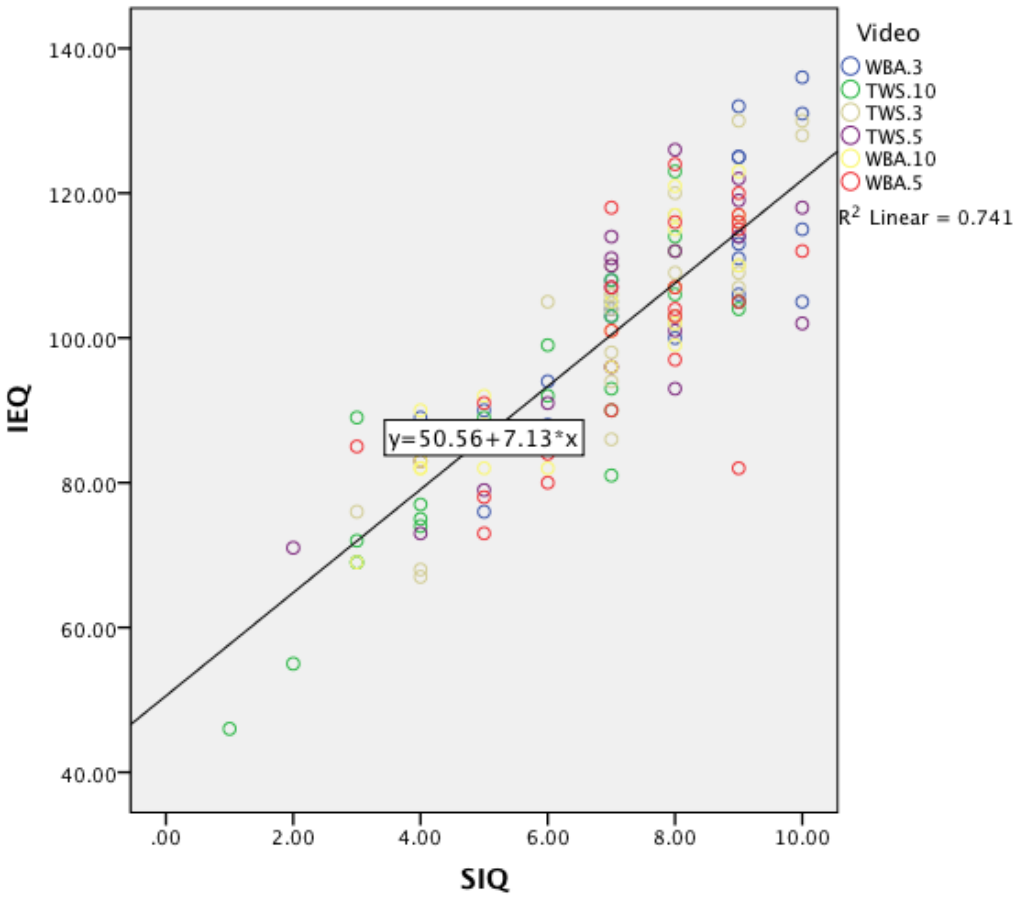
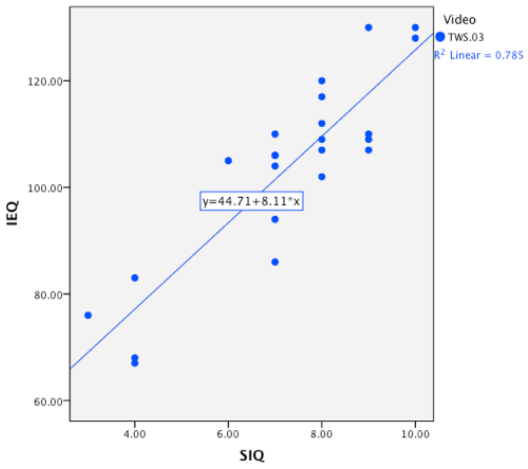


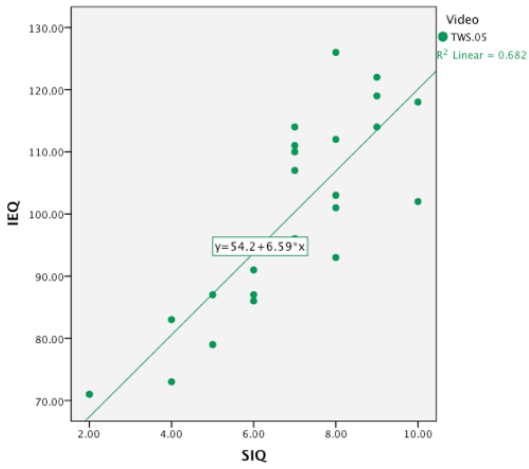
Fig. 4.11 IEQ and SIQ correlation, per video (N=144)

A scatter graph for each individual video can also be seen in Fig. 4.12. A regression line shows that each video represents a positive linear relationship.

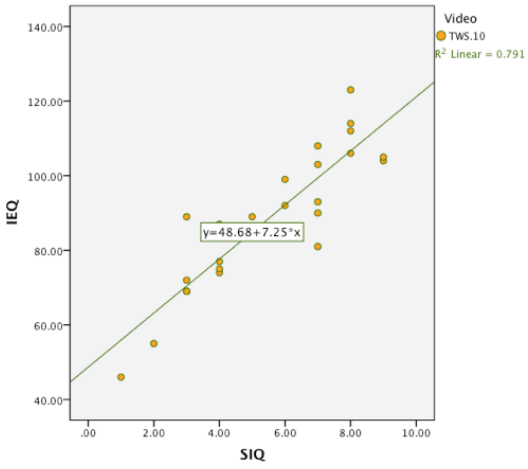
TWS.3



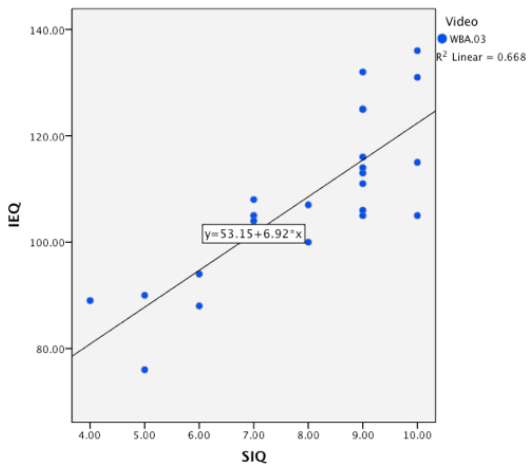
TWS. 5



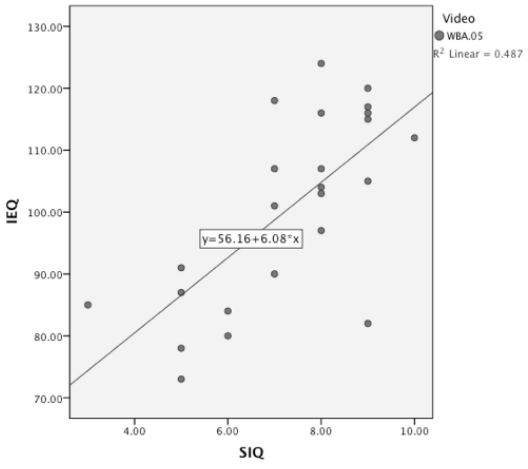
TWS.10



WBA.3



WBA.5



WBA. 10

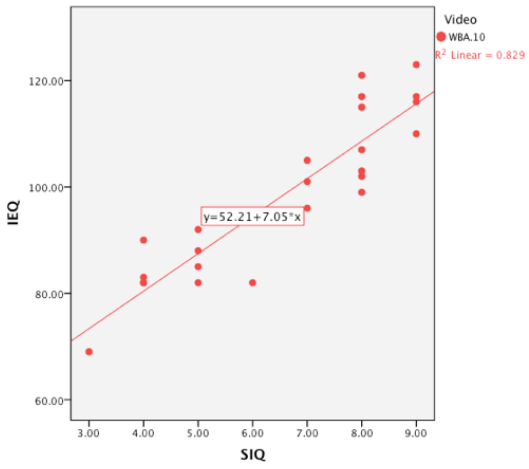


Fig. 4.12 IEQ and SIQ correlations for each condition

In conclusion these results suggest that as there is a high correlation between IEQ and SIQ scores.

4.2.7 Analysis of Difference across Six Conditions

Analysis was conducted to explore if there was a significant difference across all six video conditions for IEQ and SIQ scores.

For IEQ scores, since the sample size was small, and data was treated as non-parametric, a Friedman's analysis of variance test was performed for all 6 video lessons. From descriptive statistics it was found that longer video durations had the lowest median scores (TWS.10 = 91.5) (WBA.10 = 103.50), and shortest videos durations had the highest median scores (WBA.3=111.00) (TWS.3=110.00). The Friedman's analysis found that there was a significant difference in IEQ scores for all six video conditions, $X^2 = 26.203$, $P < .001$. Differences found between participants are unlikely to be due to sampling error.

A Friedman's analysis of variance was also conducted for all SIQ scores. The analysis found that there is significant difference in SIQ scores across all 6 conditions, $X^2 = 27.37$, $p < .001$. Previous median scores had shown that WBA.3 (Med = 9.00) scored highest for all six videos and TWS (Med = 6.00) scored lowest. Unlike the IEQ scores it was seen that some videos of longer duration scored equally or higher in SIQ scores than shorter videos: WBA.5 (Med = 8.00), TWS.5 (Med = 7.00), WBA.10 (Med = 7.00).

In conclusion, significant difference was found across all 6 video conditions for both IEQ and SIQ scores.

4.2.8 Interaction Effects Between Video Length and Style

It is known that in order to run an ANOVA, data must be drawn from a normally distributed population. As the SIQ data is not normally distributed this sample does not meet this assumption. However, as there does not appear to be a reliable equivalent of a non-parametric ANOVA with two within-participant factors, this ANOVA will be used. It is with this in mind that results should be interpreted with some caution. Further analysis will be conducted using Wilcoxon sign-ranked tests.

The IEQ scores were analysed with a repeated measures ANOVA with 2 within-participant factors of style (whiteboard vs. teacher with slides) and length (3 min vs. 5 min vs. 10 min). This analysis revealed that the main effects due to the style conditions were not significant ($F = 2.988$, $p = .097$, partial $N2 = .115$) whereas the effect of the length condition was significant ($F = 11.22$, $p < .001$, $N2 = .328$). It was also found that the interaction between video style and length was not significant ($F = 1.585$, $p = .216$, partial $N2 = .064$) (**Appendix Q**).

The same test was conducted for the SIQ data. This analysis again revealed that the main effects due to the style conditions were not significant (F = 2.944, p = .10, partial N2 = .113) whereas the effect of the length condition were (F = 14.849 p < .001, N2 = .392). Again similar to the IEQ results the interaction between video style and length was not significant (F = .846, p = .436, partial N2 = .035).

These results show that for both our IEQ and SIQ results there is no interaction effect between length and style and that presentation styles do not have a significant effect immersion.

4.2.9 Video Length and Immersion

As it was proved that video duration does affect participant's immersion scores, a number of paired Wilcoxon signed-ranked tests were conducted for both presentation styles (**Appendix Q**).

In total 2 paired tests were conducted for each presentation style, as from the observation of box plots it was seen there was significant difference between videos of 3 and 10 minutes for both styles.

The first Wilcoxon test conducted was for videos WBA.3 and WBA.5. Previous literature suggested that participants prefer shorter rather than longer mobile videos (O'Hara et al., 2007; Finamore et al. 2011,) therefore a 1-tailed probability was used. The Wilcoxon test was converted into a z-score of -2.801 with an associated 1-tailed probability of 0.002. In total 18 from 24 participants scored a lower IEQ score for WBA.5. The difference between the two video lengths bordered on significant (Wilcoxon test, z = - 2.801, p = .004). This result suggests that participants become less immersed as video length increases from 3 minutes to 5 minutes for whiteboard videos. To support IEQ findings a Wilcoxon test was conducted to explore the effect of length on SIQ scores. From descriptive statistics it can seen that the median for WBA.5 (Med = 8.00) is lower than that of WBA.3 (Med = 9.00). The Wilcoxon test was converted to a z-score of -2.207 with an associated 1-tailed probability of .017. It can therefore be concluded that there is significant difference in SIQ scores for videos WBA.3 and WBA.5.

When comparing IEQ scores for videos WBA.5 (Med = 108.00) and WBA.10 (Med = 103.50) the Wilcoxon test was converted to a z-score of -.882 which an associated 1-tail probability of .194. The Wilcoxon test converted to a z-score of -2.13 with an associated one-tailed probably of .022. This evidence shows there is a significant different in SIQ scores between these two videos. This result differs to the previous IEQ Wilcoxon score for these two video lengths (z-score = -.882, p = .389). This may be the result of participants scoring higher in SIQ scores for the video WBA.5. The reason for this is unknown but it may suggest that the SIQ doesn't work as well for mobile video lessons when comparing individual video lessons. This will have to be investigated further.

For the 'teacher with slides' style only significant difference was found for one pair.
Next, IEQ scores were compared for videos TWS.10 (91.50) and TWS.5 (106.00). The Wilcoxon signed rank test elicited a statistically significant change in immersion experience questionnaire

scores (Z = -2.745, P = .002). Again similar to our IEQ scores significant difference was found between videos TWS.5 and TWS.10. The median for TWS.10 (Med = 6.00) is less than TWS.5 (Med = 7.00) and the Wilcoxon test was converted to a z-score of -2.882 with an associated two-tailed probability of .003. We therefore concluded that there is significant difference in SIQ scores for videos of 5 minutes and 10 minutes for 'teacher with slides' style presentation.

In conclusion, the results from the Wilcoxon tests support the earlier analysis of both IEQ and SIQ box plots. The only minor discrepancy found was that the SIQ score for videos WBA.5 and WBA.10 showed a significant difference, whereas for the IEQ no difference was found. This could possibly be the result of participants scoring a higher SIQ score for the video WBA.5.

4.2.10 Impact of Presentation Style on Immersion

As it was found that it is duration that affects users' immersion levels rather than presentation style, differences in style will only be addressed briefly. The reason Wilcoxon tests were conducted for differences in presentation style was that the previous 2-factor ANOVA had been conducted for non-parametric SIQ data. The Wilcoxon tests were used to confirm that presentation style has no affect on immersion.

Detailed results from the Wilcoxon tests conducted can be found in **Appendix Q**.

As it was unclear if one presentation style would be more effective than the other, a 1-tailed significance level was used. For the IEQ scores significant difference was found only between videos WBA.10 (Med = 100.00) and TWS.10 (Med = 89.50). The Wilcoxon signed-rank test was converted to a z-score of -2.343 with an associated two-tailed probability of .017. However, this result was not found to be true for SIQ scores (Med = 7.00) and TWS.10 (Med = 6.00) as the Wilcoxon test was converted to a z-score of -1.752 with an associated two-tailed probability of .082.

4.2.11 Discussion

From the statistical analysis conduced it was found that changes to video lesson presentation style has no affect on participants immersion levels, but video duration does. In the context of this research this means the null hypothesis that there is no difference in participant's levels of engagement related to the presentation style was found to be true. However, the null hypothesis that there is no difference in participant's levels of engagement related to the duration of a mobile video lesson was not supported.

These results reflect the feedback from participant interviews. Participants were generally divided on which they presentation style the learned more from. In total 14 respondents preferred the whiteboard animation and 10 preferred the 'teacher with slides' style. Due to the split in preference there is little surprise that no significance difference was found between the two presentation styles.

From 24 participants 20 said that they felt that the duration of the mobile lessons influenced their ability to learn. Participants appeared to find the longer 10-minute videos particularly challenging and comments included that they were "quite draining" and it was just "information overload". Previous literature also supports these findings. O'Hara et al. (2007: 858) report that the major development from the study they conducted on consuming video was mobile devices, was the prominence of very short viewing periods. Peng et al (in Melhuish and Falloon: 2010:9) advise that mobile devices are not associated with deep learning experiences, which suggests that participant learning should be kept short and sharp. Considering the findings from this research this seems like sound advice. Although outside of the spectre of learning, Finamore et al. (2011) found that for participants viewing YoutTube videos on mobile devices 60% of all videos were for viewed for no more that 20% of the video duration. These figures support the view that mobile usage is more suited to shorter video duration times as users become easily distracted either by their surrounding environment or other factors.

What is an interesting find from this study is that video duration appears to have different effects on each presentation style. For the 'teacher with slides' style, the length of the video has very little effect on immersion up to the point of five minutes. Alternatively immersion levels dropped significantly from 3 minutes to 5 minutes for whiteboard videos, with immersion levels remaining at a consistent level from 5 minutes to 10 levels. Previous literature was explored to try to provide some further explanation on the subject, however little research has been conducted on whiteboard animated videos related to learning. A possible suggestion was that this result may have be due to the 'busyness' of the visual handwriting and picture drawing, where after a certain point it become too much for the viewer to process. However no previous research was found to support this.

These findings show that for whiteboard animations once the 3-minute period is passed, immersion levels drop and that after this point video duration has little effect on immersion levels, certainly up to 10 minutes. Therefore advice for teachers would be to keep whiteboard animated videos as short as possible. Interestingly the 'teacher with slides' style video appears to hold participants attention for longer, this is contrary to the general belief that whiteboard animation keeps users' engaged for longer periods.

The final important result is that there is a strong correlation between IEQ and SIQ scores for mobile video learning on smartphones. This was yet to be proved for mobile learning and means that this is a reliable measure of participants' immersion, which can be used for future studies. Previously the SIQ had only been used by Jennett et al. (2008), to prove the accuracy of IEQ scores using a Pearson correlation. An attempt was made in this study to use the SIQ to measire the immersion levels of each independent condition. It was thought that if the SIQ could provide an accurate measure of immersion in line with the IEQ for each video, then it could possibly be used as a 'stand alone' measurement. This was not to be the case as the SIQ was found to be lacking in consistency when measuring immersion. Although it may useful to prove the accuracy of the IEQ, it lacks the detail needed to be used as a solitary measurement tool. Future researchers are

advised to stick to the IEQ instead, which provides a more detailed and refined measurement of immersion.

4.3 Immersion Factor Findings

Although this is not a main objective of this study, the IEQ provides an opportunity to measure individual components of immersion. It was thought that the measurement of these factors may be of interest to the reader. According to Jennett (2010) it is not clear what the characteristics of these immersion factors are, or how they are related to one another. Therefore a very brief overview of each result for this study will be provided.

4.3.1 Cognitive Involvement

Cognitive involvement focuses on measuring effort and attention. An example related to these video lessons would be the extent that participants felt focused on the lesson.

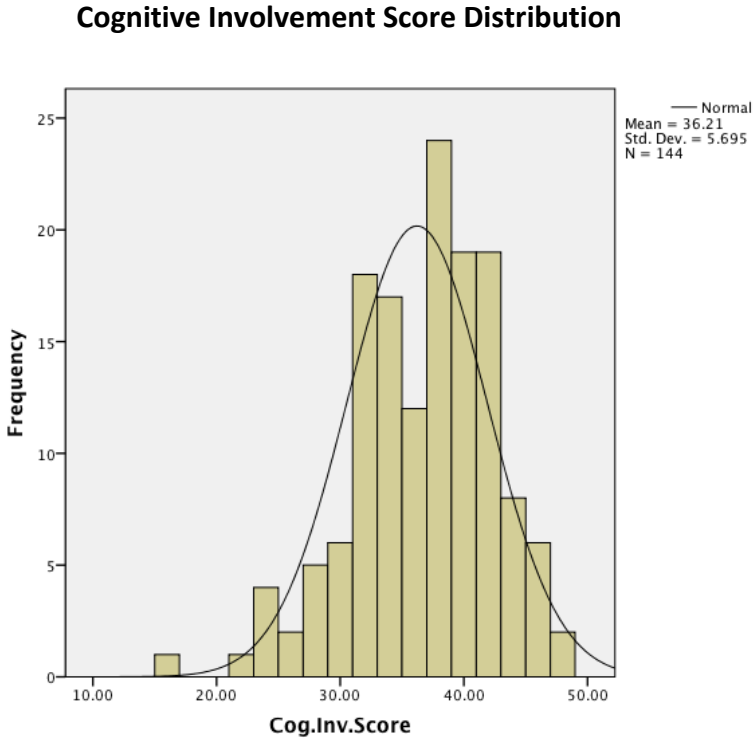


Fig. 4.13 Cognitive Involvement score distribution (N=144)

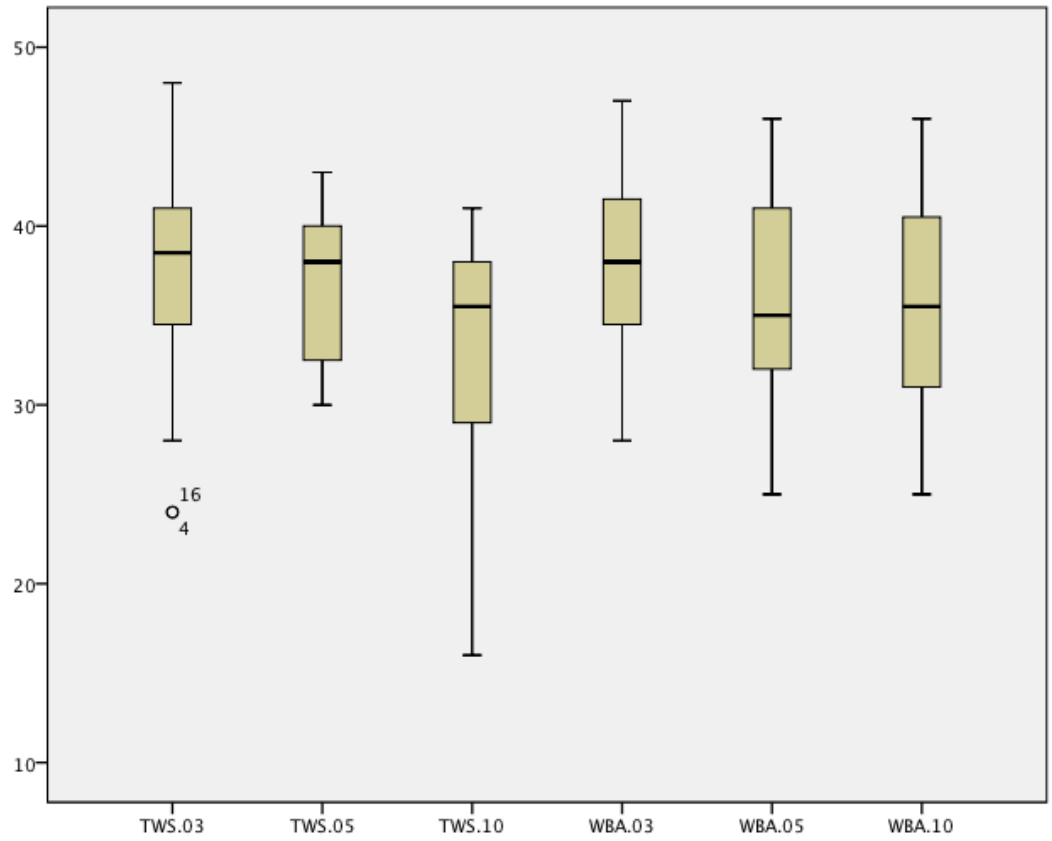


Fig. 4.14 Cognitive involvement box plots, per video

Cognitive Involvement	N	Mean	Median	Standard Deviation	95% Confidence Interval Mean	
					Lower	Upper
All Conditions	144	36.21	37.00	5.70	35.27	37.15
TWS.3	24	37.33	38.50	6.13	34.74	39.92
TWS.5	24	36.92	38.00	4.13	35.17	38.66
TWS.10	24	33.13	35.50	6.63	30.33	35.92
WBA.3	24	38.21	38.00	4.79	36.19	40.23
WBA.5	24	35.92	35.00	5.76	33.49	38.35
WBA.10	24	35.75	35.50	5.54	33.41	38.09

Fig. 4.15 Cognitive involvement descriptive statistics

Since the sample size was small and data nor normally distributed a Friedman's Analysis Test of Variance was used to determine the differences in cognitive involvement factor scores across all six videos. Results gave an X^2 of 12.396 with an associated probability value of 0.03. The differences found between participants for different videos are unlikely to be due to sampling error. Thus it was concluded that there are significant differences in cognitive involvement factors for all 6 videos.

4.3.2 Real World Dissociation

Real world dissociation refers to participants' lack of awareness in relation to their surroundings. It is a state of consciousness when users are seen to block everything else out, besides what they are concentrating on.

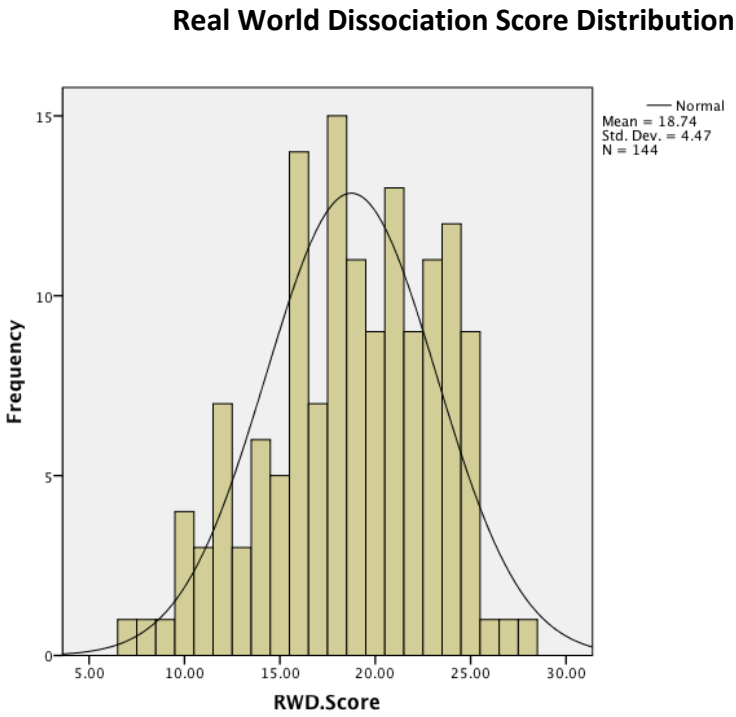


Fig. 4.16 Real world dissociation score distribution (N=144)

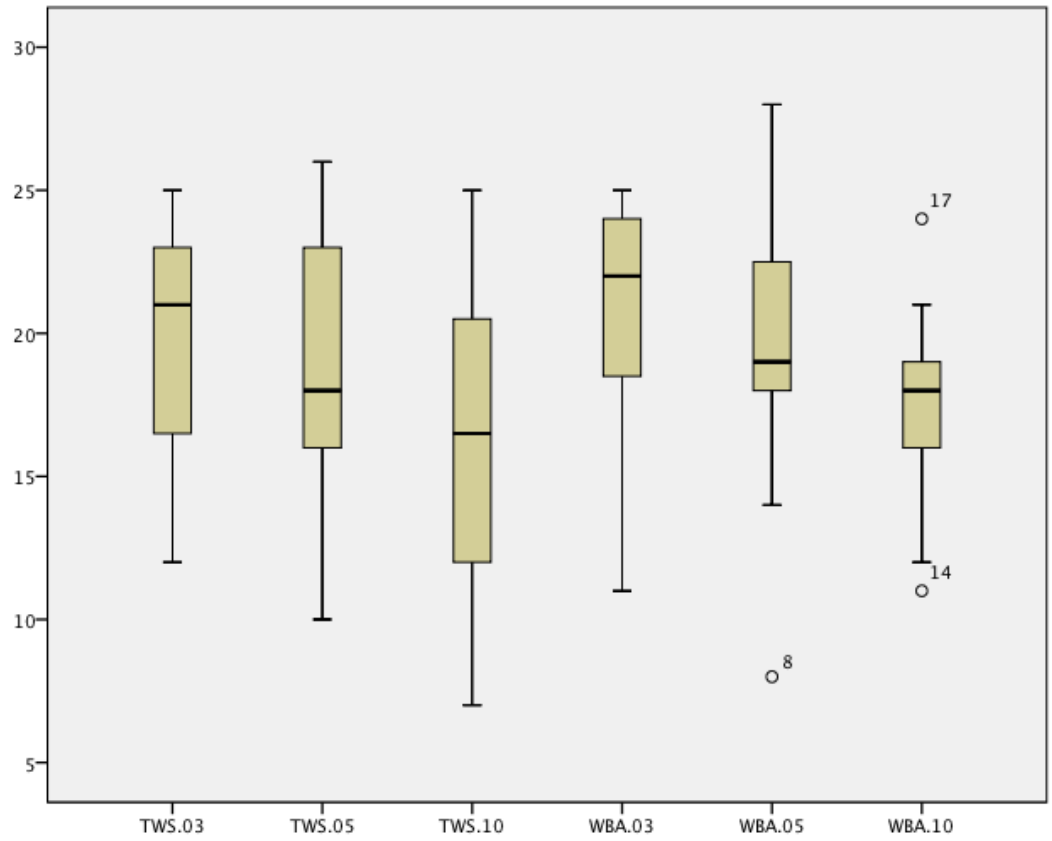


Fig. 4.17 Real world dissociation box plots, per video

Real World Dissociation	N	Mean	Median	Standard Deviation	95% Confidence Interval Mean	
					Lower	Upper
All Conditions	144	18.74	19.00	4.47	18.01	19.48
TWS.3	24	19.71	21.00	3.78	18.11	21.31
TWS.5	24	18.79	18.00	4.86	16.74	20.85
TWS.10	24	16.13	16.50	5.12	13.96	18.29
WBA.3	24	20.96	22.00	3.95	19.29	22.63
WBA.5	24	19.42	19.00	4.47	17.53	21.30
WBA.10	24	17.46	18.00	3.01	16.19	18.73

Fig. 4.18 Real world dissociation descriptive statistics

A Friedman's Variance of Analysis was conducted to explore if there were significant differences between real world dissociation scores for the 6 videos. Results provided an X^2 of 20.142 with an associated probability of .001. The difference found between participant's scores are unlikely to be due to sampling error.

4.3.3 Emotional Involvement

Emotional involvement measures users levels of participants' affect and suspense. An example of this question would be users eagerness to see what will come next in the lesson.

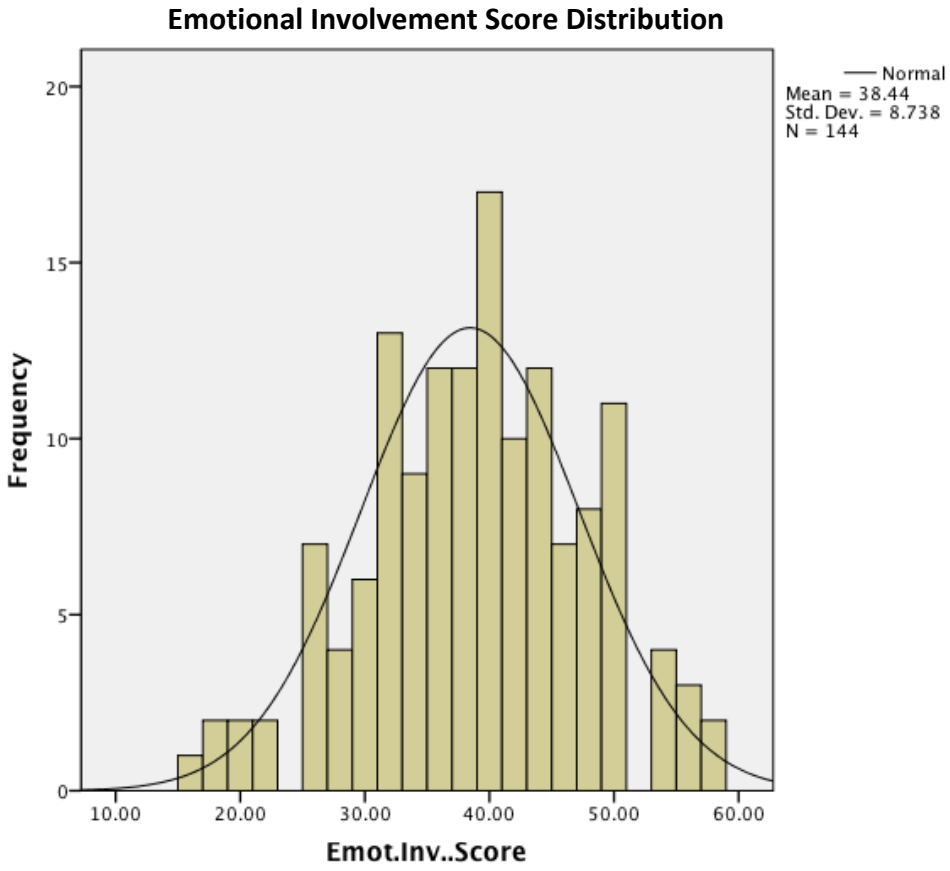


Fig. 4.19 Emotional involvement score distribution (N=144)

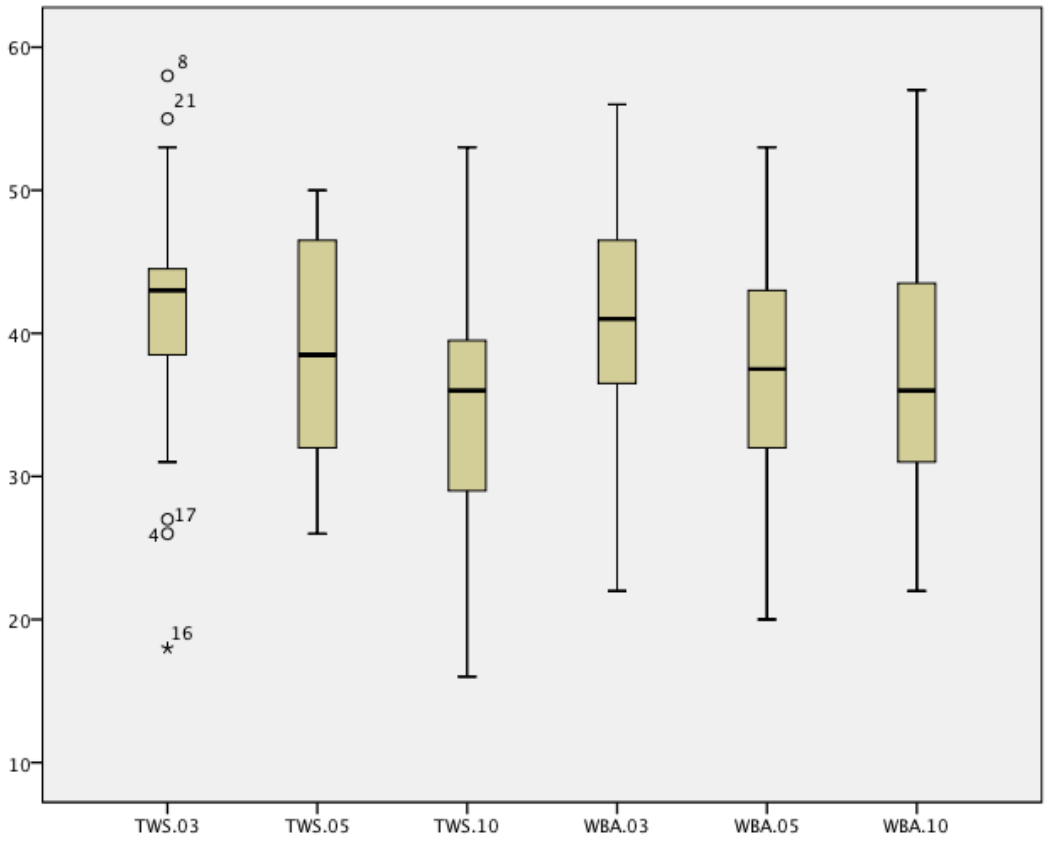


Fig. 4.20 Emotional involvement box plots, per video

Emotional Involvement	N	Mean	Median	Standard Deviation	95% Confidence Interval Mean	
					Lower	Upper
All Conditions	144	38.44	39.00	8.74	37.01	39.88
TWS.3	24	41.08	43.00	9.01	37.28	44.89
TWS.5	24	38.75	38.50	7.89	35.42	42.08
TWS.10	24	34.04	36.00	9.06	30.22	37.87
WBA.3	24	41.67	41.00	8.04	38.27	45.06
WBA.5	24	37.67	37.50	8.18	34.21	41.12
WBA.10	24	37.46	36.00	8.83	33.73	41.19

Fig. 4.21 Emotional involvement descriptive statistics

A Friedman's Analysis of Variance test was conducted to measure if there was any difference in emotional involvement across all six videos. Results gave an X^2 of 22.868 with an associated probability of $p < 0.001$. From this we can conclude that there are significant differences in participant's emotional involvement scores across all six videos.

Emotional involvement results uncovered were very similar for both presentation styles. No one style is seen to be more effective than the other.

4.3.4 Challenge

Challenge refers to how difficult the participant found the video lesson. An example of this would be the question from the IEQ 'were there times during the game where you wanted to give up?

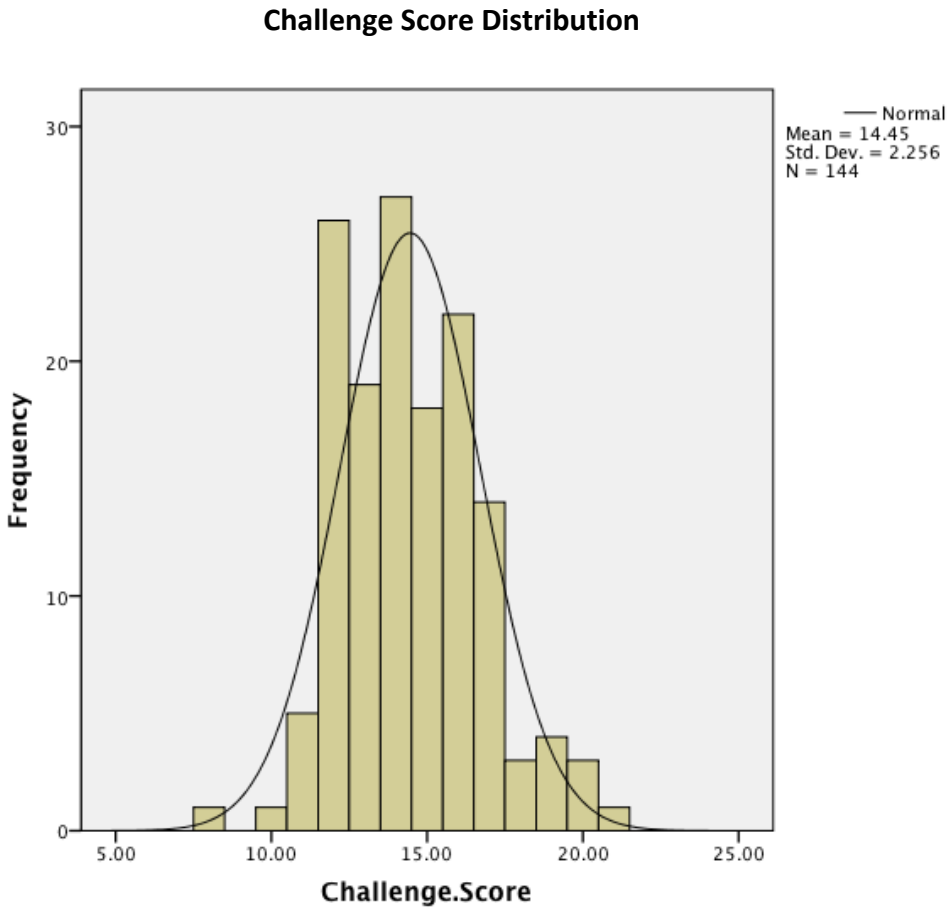


Fig. 4.22 Challenge score distribution (N=144)

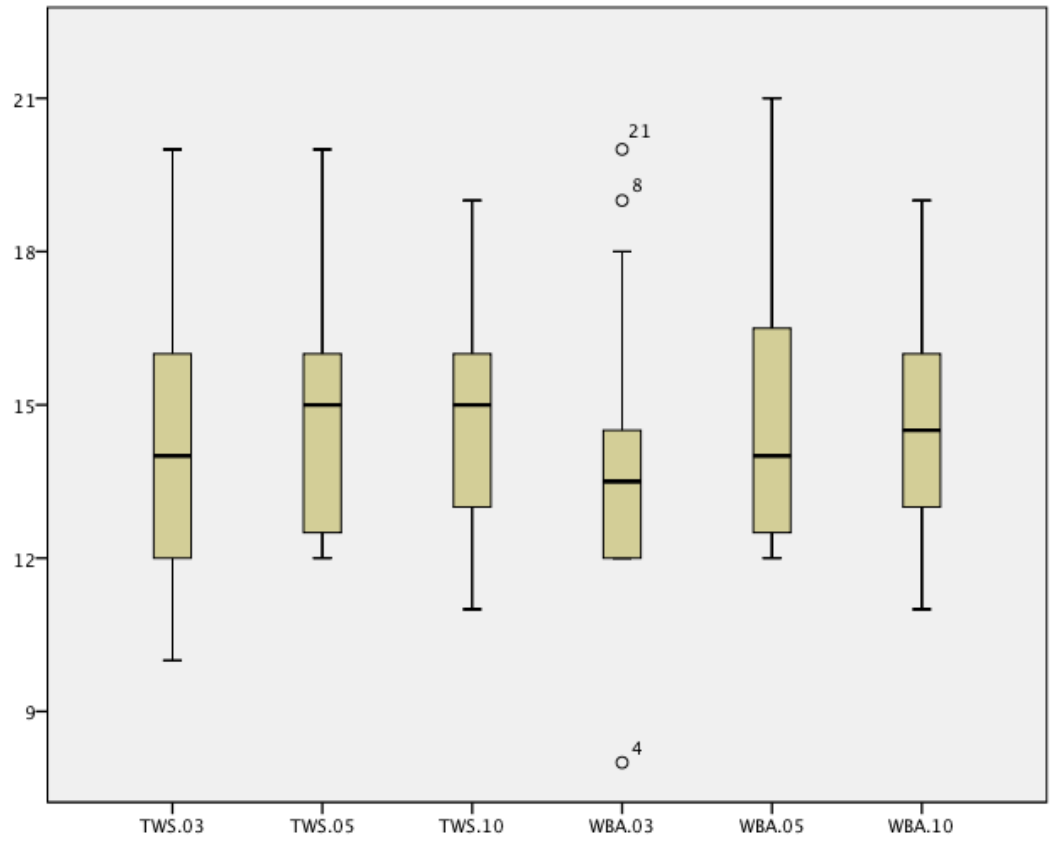


Fig. 4.26 Challenge box plots, per video

Challenge	N	Mean	Median	Standard Deviation	95% Confidence Interval Mean	
					Lower	Upper
All Conditions	144	14.45	14.00	2.26	14.08	14.82
TWS.3	24	14.21	14.00	2.47	13.17	15.25
TWS.5	24	14.58	15.00	2.10	13.69	15.47
TWS.10	24	14.71	15.00	1.83	13.94	15.48
WBA.3	24	13.79	13.50	2.50	12.74	14.84
WBA.5	24	14.63	14.00	2.39	13.61	15.64
WBA.10	24	14.79	14.50	2.25	13.84	15.74

Fig. 4.23 Challenge descriptive statistics

A Friedman's of Variance test was performed for all six videos to investigate if there was any difference in challenge factor scores amongst participants. Results showed an X^2 of 4.795 with an associated probability value of .441. This indicates that there are no significant differences in challenge factors when comparing all six videos.

4.3.5 Control

Control refers to the ease of use of the interface used in the interaction. This measurement is certainly more applicable to video gaming. For this study participants were not required to interact with any interface controls, therefore this factor can be ignored.

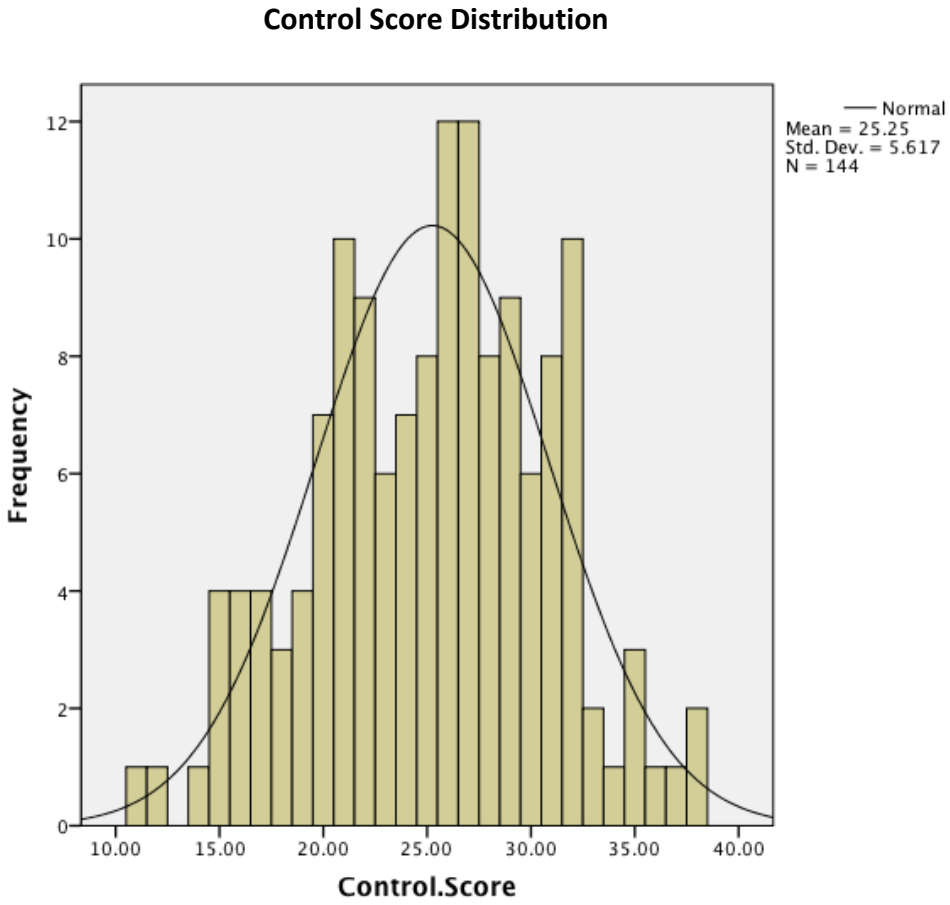


Fig. 4.24 Control score distributions (N=144)

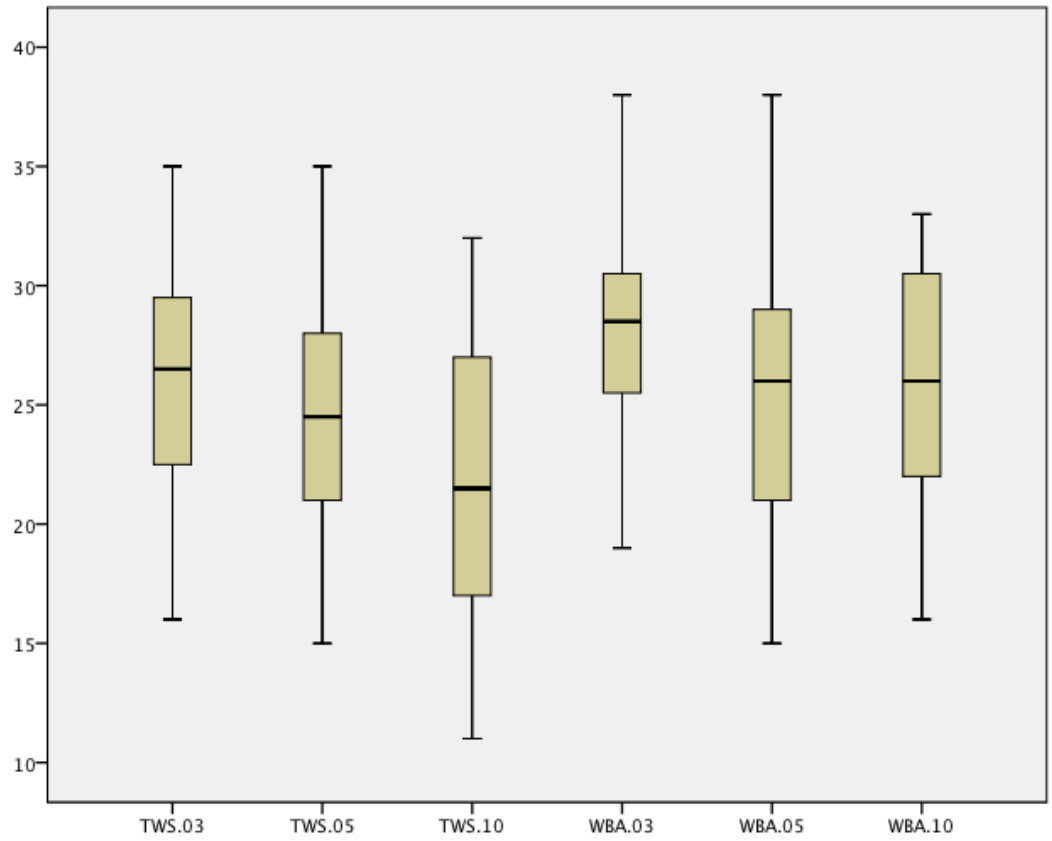


Fig. 4.25 Control box plots, per condition

Control	N	Mean	Median	Standard Deviation	95% Confidence Interval Mean	
					Lower	Upper
All Conditions	144	25.25	26.00	5.62	24.32	26.18
TWS.3	24	25.63	26.50	5.59	23.26	27.99
TWS.5	24	24.29	24.50	5.30	22.05	26.53
TWS.10	24	21.83	21.50	6.15	19.24	24.43
WBA.3	24	28.25	28.50	4.70	26.26	30.24
WBA.5	24	25.58	26.00	5.33	23.33	27.83
WBA.10	24	25.92	26.00	5.01	23.80	28.03

Fig. 4.26 Control descriptive statistics

4.3.6 Discussion

This section presented figures related to individual immersion factors. The purpose of this research was to measure immersion as a whole; therefore individual factors of immersion were investigated very briefly.

4.4 Effect of Immersion on Learning

4.4.1 Post-Lesson Examination

A Shapiro-Wilk's test (p>.05) (Shapiro & Wilk, 1965; Razali & Wah, 2011) and a visual inspection of their histograms, normal Q-Q plots and box plots showed that post lesson examination scores were not normally distributed for all videos. Our null hypothesis was that data was normally distributed, however it was rejected for videos TWS.3 and WBA.3 as their p-values were below 0.05 (**Appendix Q**). As data is not normally distributed it will be treated as non-parametric.

4.4.2 Participant Exam Findings

The mean post-lesson exam scores for all 24 participants each watching 6 videos was 23.72. This is from a maximum score of 100. The confidence intervals for each individual condition are shown in Fig. 4.31 (**Appendix Q**) and an error bar chart can be seen in Fig. 4.28. Participants post-lesson exam scores were highest for the 3-minute teacher with slides video TWS.3 (M = 35.75, SD = 14.27) and lowest for the 10-minute teacher with slides video TWS.10 (M = 9.04, SD = 4.36).

From the observation of Fig. 4.27 it can be seen that as the length of video lessons increase for both presentation styles, participants mean post-lesson examination scores decrease.

Post-Lesson Exam Scores	N	Mean	Standard Deviation	95% Confidence Interval Mean	
				Lower	Upper
All Conditions	144	23.72	13.67	21.58	25.94
TWS.3	24	35.75	14.27	30.04	41.46
TWS.5	24	25.38	11.29	20.71	29.79
TWS.10	24	9.04	4.36	7.38	10.87
WBA.3	24	29.00	9.17	25.50	32.67
WBA.5	24	27.63	12.94	22.58	32.38
WBA.10	24	15.50	8.12	12.50	18.71

Fig. 4.27 Post-lesson exam scores descriptive statistics (N=144)

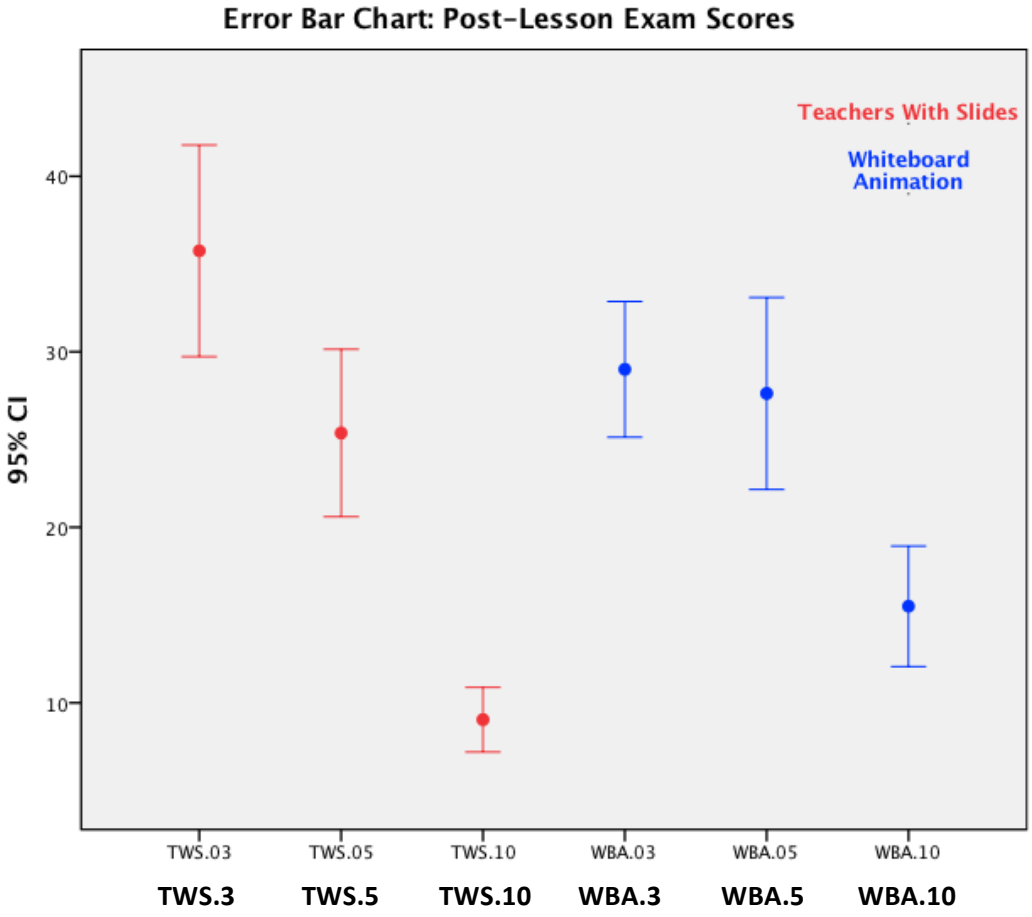


Fig. 4.28 Post-lesson exam score error bar chat, per video

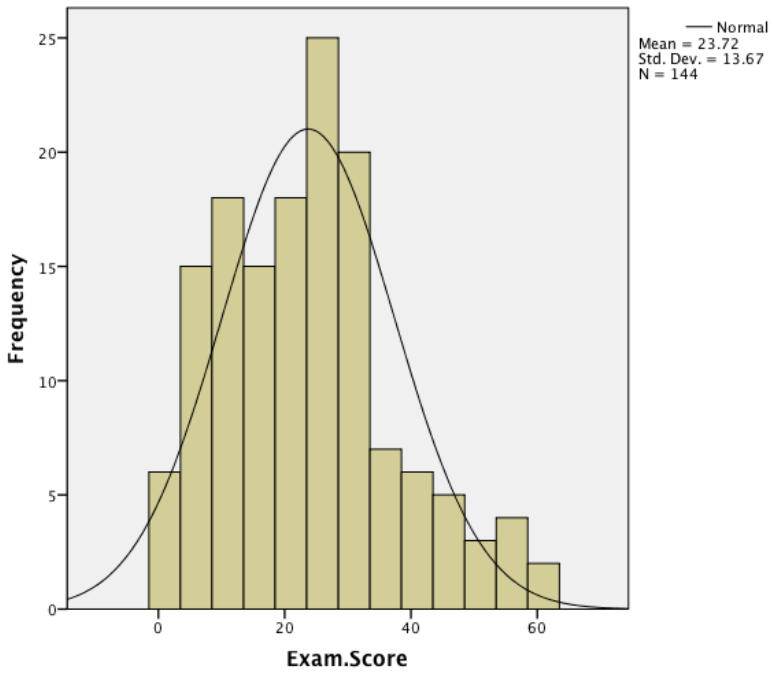


Fig. 4.29 Post-Lesson exam scores frequency distribution (N=144)

From the observation of post-lesson exam score box plots in Fig. 4.30 and median scores results in Fig 4.31, there appears to be significant difference between all three 'teacher with slides' video lessons. Significant difference can be seen between videos TWS.3 (Med = 32.00) differs and TWS.5 (Med = 25.00) and thirdly videos TWS.5 (Med = 25.00.00) and TWS.10 (Med = 9.00). Participants scored higher results for the shorter 'teacher with slides' videos, with very little overlap in h-spreads among all three videos.

This is very much in contrast to our whiteboard-animated videos. There is clearly overlap in h-spreads and very little difference between videos WBA.3 (Med = 25.00) and WBA.5 (Med = 27.50), with video WBA.5 scoring higher in median score. Significant difference can be seen between videos WBA.5 (Med = 27.50) and WBA.10 (Med = 18.00).

Post-Lesson Exam Box Plots

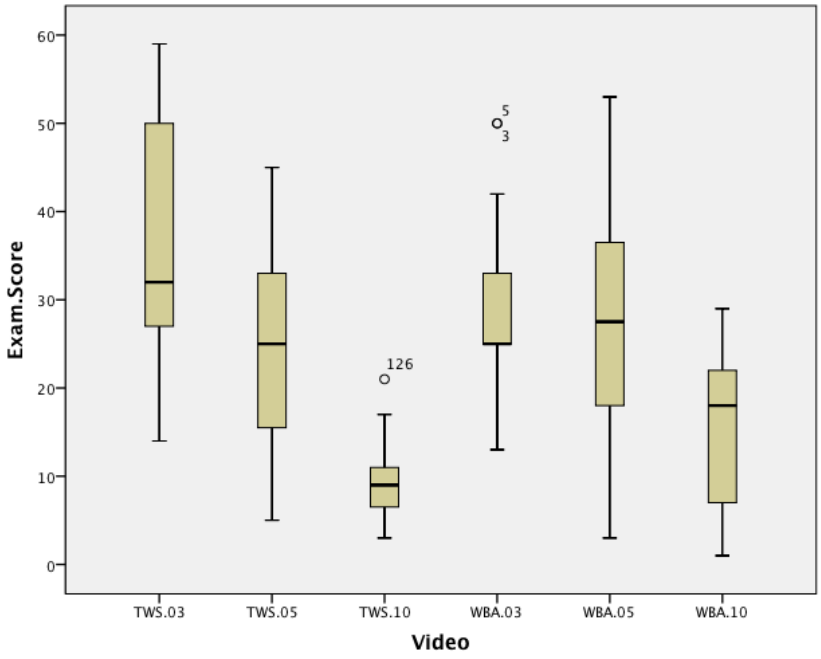


Fig. 4.30 Post-Lesson Exam Score Box Plots, per Video

Post-Lesson Exam Scores	N	Median	Std. Error	95% Confidence Interval Median	
				Lower	Upper
All Conditions	144	23.50	1.61	20.00	25.00
TWS.3	24	32.00	4.62	27.00	42.95
TWS.5	24	25.00	3.78	18.00	32.00
TWS.10	24	9.00	.97	7.00	10.50
WBA.3	24	25.00	2.52	25.00	33.00
WBA.5	24	27.50	3.09	22.50	33.00
WBA.10	24	18.00	2.86	10.00	20.50

Fig. 4.31 Post-Lesson Exam Median Scores, Per Video

These results suggest that there is a much greater degree of variation in exam results for the 'teacher with slides' videos. As durations become longer for this style, participants exam score drop significantly. What is also an interesting development is that whiteboard animated video showed very little difference in exam score between the 3 and 5 minute videos. It also appears that the 'teacher with slides' 3-minute video lesson scored significantly higher than the whiteboard 3-minute lesson, but there was quite a significant drop in scores when the 'teacher with slides' duration was increased from 3 to 5 minutes.

4.4.3 Relationship between learning and immersion

Box plots for post-lesson exam scores, IEQ scores and SIQ scores can be seen below in Fig. 4.32. From these results there appears to be a visible differences between post-lesson exam and immersion results, whereas IEQ scores and SIQ scores are very similar.

Similar to IEQ and SIQ results, post-lesson scores decline over time showing less overlap in h-spreads, with the exception of videos WBA.3 and WBA.5. What is interesting to note is the steeper decline in the 'teacher with slides' exam scores when compared to IEQ and SIQ scores. It appears that post-lesson exam results were extremely low for the video TWS.10, whereas its decline in immersion scores was far less. Whiteboard animated 3 and 5-minute post-lesson examination scores appear similar to their immersion scores, however for the whiteboard 10-minute video post-lesson exam scores were considerably lower than the immersion score.

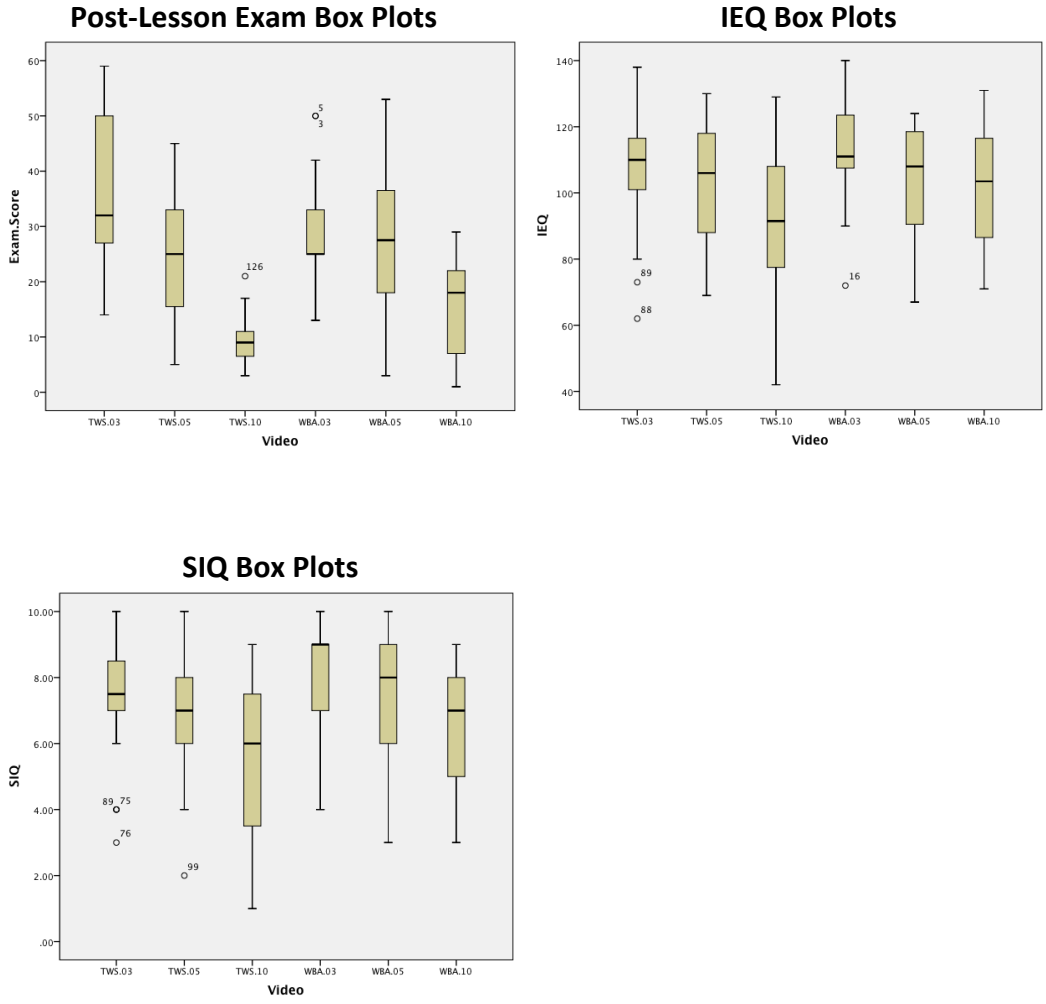


Fig. 4.32 Box Plots Per Video for Post-Lesson Exam Score, IEQ & SIQ Scores

It was investigated if there was a correlation between participant levels of immersion and post-lesson exam scores.

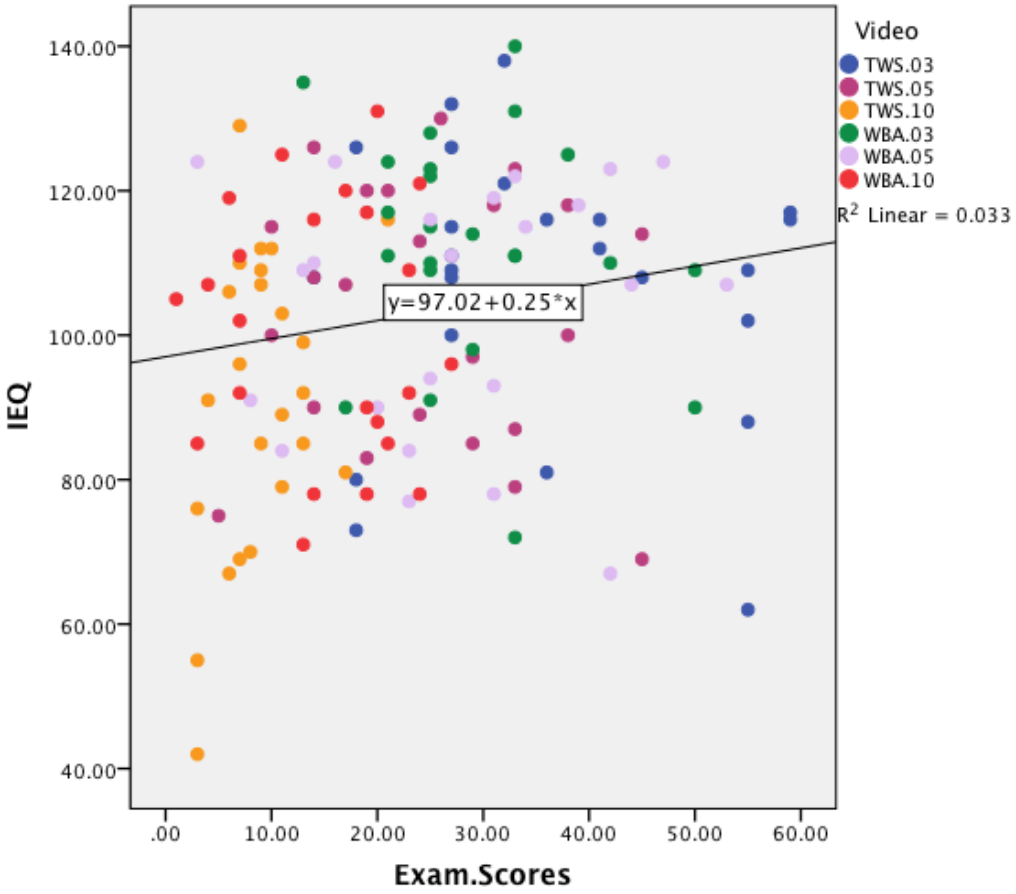


Fig.4.33 Dispersion of IEQ and Post-Lesson Exam Score, N=144

From the Spearman's rho test it can be seen that as IEQ results increase so do participants exam scores. The correlation between IEQ and exam scores is .210. This correlation has a small chance of arising from sampling error (P = .006).

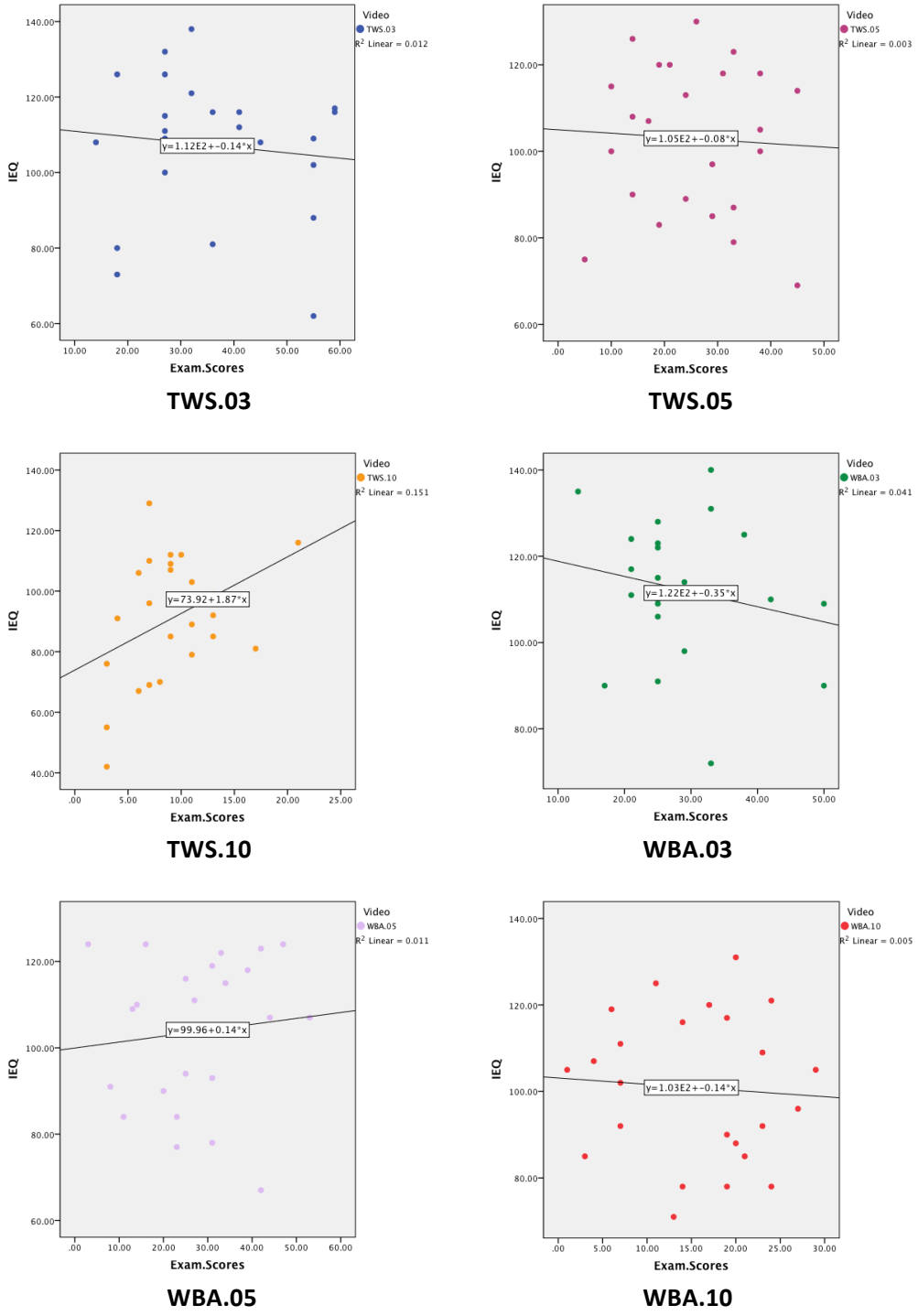


Fig.4.34 Correlations per video

The results uncovered are somewhat unexpected. It was expected that this correlation would be higher. The reason for this may be the low percentages scores that were awarded to participants for each exam. The reason for these low scores were that the post-lesson exam was mainly fact based. The range of participants' IEQ scores was 98, whereas the range for participant's exam

scores was only 58. Participants also scored a higher mean (102.98) for the IEQ across the larger range (min = 42, max = 140), whereas the mean score for exams (23.72) was for a smaller ranger (min = 1.00, max = 59). This may have resulted in a lower than expected correlation rating. As well as a potential error in the examination scoring criteria, it has to be considered that there may be other factors that need consideration when studying mobile video learning.

We have found that there is a correlation between immersion and learning, but it appears to be weak. This suggests that other factors may need further research that may contribute to mobile learning. We have found that immersion is important but immersion in relation to learning may be more complex than first thought.

Measurement	N	Range	Minimum	Maximum	Mean	Standard Deviation
IEQ Scores	144	98.00	42.00	140.00	102.97	18.81
Post-Lesson Exam Scores	144	58.00	1.00	59.00	23.72	13.67

Fig.4.35 Descriptive statistics for post lesson exam and IEQ scores (N=144)

To be conclusive in our findings we also ran a correlation between SIQ (single immersion question) scores and post lesson exam results. Fig 4.36 shows their distribution when compared.

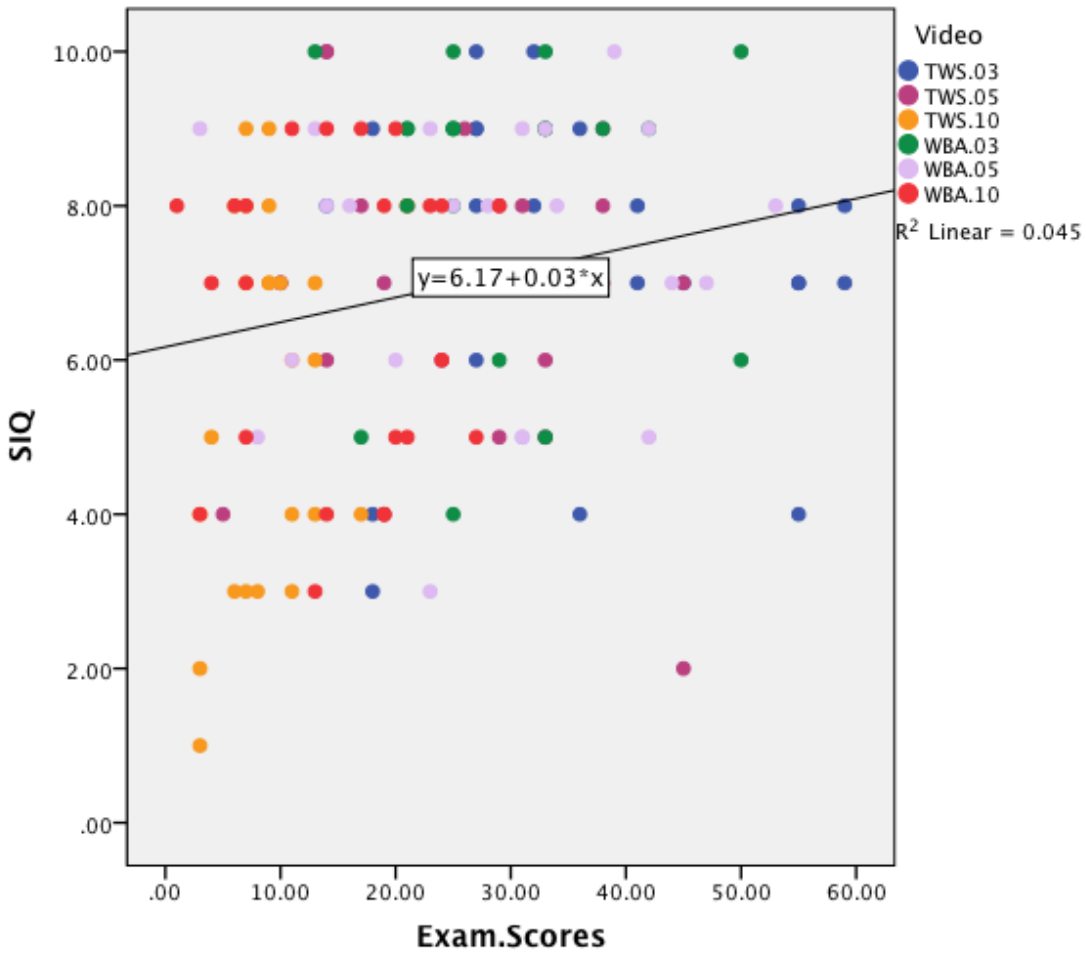
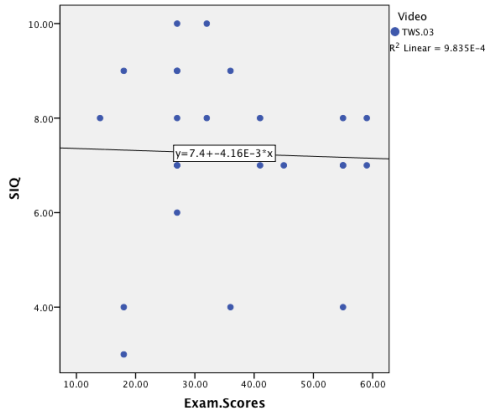


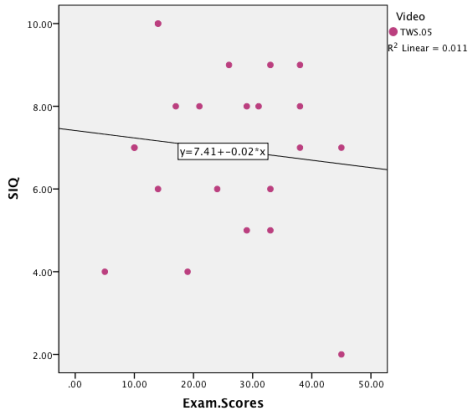
Fig.4.36

A Spearman's rho was conducted across 144 sets of scores. The correlation between the SIQ and post lesson exam was .215. This correlation has a small chance of arising from sampling error ($p < .005$) assuming the null hypothesis to be true. The relationship between SIQ and exam scores was found to be positively related ($r = .215$, $p < .005$). Thus as SIQ scores increase so does participants examination performance.

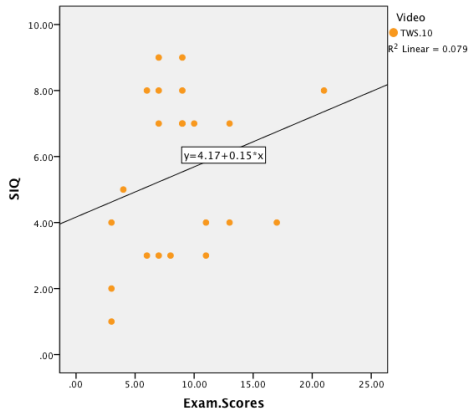
Below in Fig.4.37 each video is investigated in more detail.



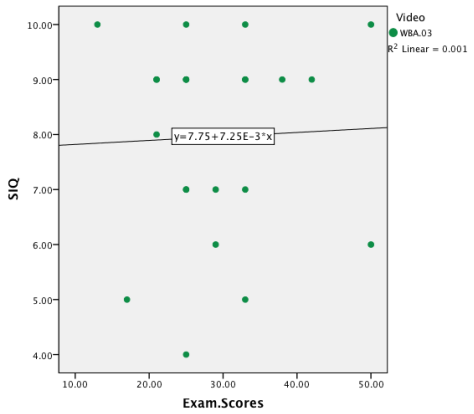
TWS.03



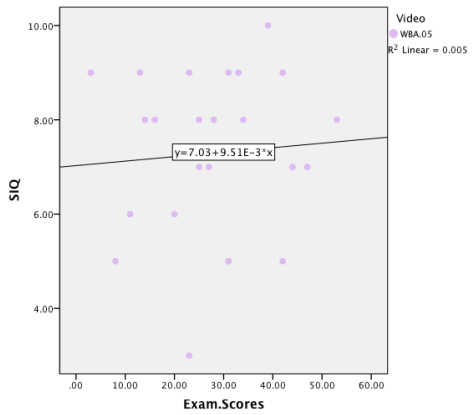
TWS.05



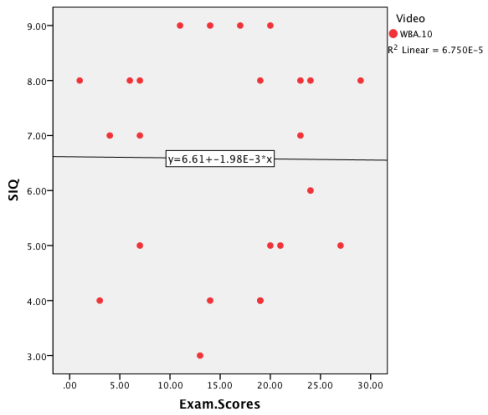
TWS.10



WBA.03



WBA.05



WBA.10

Fig.4.37

From the above we can conclude that there is appear to be a correlation between IEQ and post-lesson exam scores (r_s =.21), and SIQ and post-lesson exam scores (r_s =.215) however, for both cases their correlation coefficient appears to be positive but weak.

4.4.4 Analysis of Difference for Six Conditions

For post-lesson examination results it was explored if there was significant difference for all 6 videos. As our data was treated as non parametric a Friedman's Analysis of Variance test was performed to determine differences in scores. To recap on previous findings video the highest median score was for video TWS.03 (Med = 32.00) and the lowest for video TWS.10 (Med = 9.00). Similar to IEQ and SIQ findings as video length increased for both presentation styles, lower median scores were seen. This was with the exception of videos WBA.3 (Med = 25.00) and WBA.5 (Med = 27.50).

The Freidman Analysis of Variance results gave a X^2 value of 81.528 with an associated probability of $P < .001$. Thus it was concluded that there are significant differences in post-lesson exam score for all video conditions. Differences found between participants are unlikely to be due to sampling error.

In conclusion significant difference was found among all 6 video conditions for both participants post-lesson exam scores. Further investigation was conducted find what characteristics of mobile video lessons cause this effect.

4.4.5 Interaction Effects between Video Length and Style

For participants post-lesson examination scores it was shown using a Friedman analysis of variance test that there is significant difference in exam scores for all six videos. To investigate whether there is an interaction effect between video length and presentation style a two factor within-participants ANOVA was conducted. As mentioned previously for the two-factor ANOVA for IEQ and SIQ, it is known that data must be drawn from a normally distributed however it was considered to be the most reliable option.

The exam scores were analysed with a repeated measures ANOVA with two within-participant factors of style (whiteboard vs. teacher with slides) and length (3 min vs. 5 min vs. 10 min). The analysis revealed that the main effects due to the style conditions were not significant ($F = .489$, $p = .491$, partial $N2 = .021$) whereas the effect of the length condition was significant ($F = 94.528$, $p < .001$, $N2 = .804$). Additionally, the interaction between video style and length was significant ($F = 9.965$, $p < .001$, partial $N2 = .302$).

These results show that for post-lesson examination scores video duration has a significant effect on participant results whereas this is not the case for video presentation style. However, there was an interaction effect found between video duration and presentation style.

4.4.6 Impact of Video Length on Participant Scores

To explore the effect of video length on participant examination scores a number of paired Wilcoxon signed-rank tests were run (**Appendix Q**). Six paired tests were ran to explore the impact that video duration had on each presentation style. As with previous immersion results, it was

expected that a decrease in exam performance would be seen as video duration increased, therefore a 1-tailed significance was used in the calculation.

No difference was found between videos WBA.3 and WBA.5. When compared videos WBA.5 (Med = 27.50) and WBA.10 (18.00) showed a z-score of -3.819 with an associated 1-tailed probability of $p < .001$. This result suggests that there is a point between 5 minutes and 10 minutes for whiteboard animation lessons, that if exceed it has significant effect on participants ability to learn. When immersion was measured for these two videos there were contrasting results, the IEQ score showed no significant difference, whereas SIQ scores did. This was attributed to the possibly to the difference in scales between the IEQ and the SIQ.

Next the 'teacher with slides' presentation style was explored. Results show that there was significant difference for all of three pairs. A Wilcoxon signed rank test showed that an increase of video length from TWS.3 (Med = 32.00) to TWS.5 (Med = 25.00) did elicit a statistically significant change scoring with a z-score of -3.418 with an associated 1-tailed probability of $p < .001$. This is quite an interesting development as this conflicts with both IEQ and SIQ scores for videos TWS.3 and TWS.5, which did not show any difference. When videos TWS.5 (Med = 25.00) and TWS.10 (Med = 9.00) were explored significant difference in exam scores were found. The Wilcoxon test showed that an increase in length from 5 minutes to 10 minutes for 'teacher with slides' style video lesson elicited a statistically significant change in examination scores with a z-score of -4.287 and an associated 1-tailed probability of $p < .001$. This result is support by both IEQ and SIQ scores, which also showed significant difference.

4.4.7 Impact of Presentation Style on Participant Scores

As there was an interaction effect between video lesson length and style and our data was non-parametric for our two factor ANOVA, difference in exam score for presentation type were explored. For these Wilcoxon tests 2-tailed probability was used.

The first test ran compared videos WBA.3 and TWS.3. The appropriated measure of central tendency was the median, which in this case was lower for the WBA.3 condition (Med = 25.00) than that of the TWS.3 condition (32.00). The Wilcoxon test was converted to a z-score of -2.403 with an associated 2-tailed probability of 0.015. This result demonstrates that there is significant difference in participant's ability to learn dependent on presentation style, for the 3-minute video duration. When tested the differences between videos WBA.5 and TWS.5 did not border on significant.

Finally videos WBA.10 and TWS.10 were explored. The median score for video WBA.10 (Med = 18.00) was significantly higher that TWS.10 (9.00). The Wilcoxon test was converted to a z-score of -3.413 with an associated 2-tailed probability of $p < .001$. When previous immersion scores are observed significant difference was found for IEQ scores ($p = .017$). This shows the same pattern as the examination results. No significant difference was found for SIQ scores.

To conclude it appears that there is no clear presentation style that is more effective than the other when participant learning is concerned.

4.4.8 Discussion

From the results uncovered in post-lesson exam scores the null hypothesis that there is no relationship between participant's levels of engagement and their ability to learn using a smartphone device, was not supported. However, a weak correlation was found between post-lesson exam scores and IEQ and SIQ scores. At first it was thought that differences in measurement scales may have been the reason for this, and that an error had been made in marking the exam criteria. However, in conclusion participants ability to learn using a smartphone device may be related to more than just immersion. To test users ability to learn other factor may be considered such as presence, flow, psychological absorption (Brockmyer et al. 2009). Cognitive demand may also play a significant role.

Due to the lack of previous research in relation to video learning on mobile devices and research on whiteboard animated videos, it is difficult to find previous literature that might support reasons for this result.

4.5 Overall Discussion

The overall results concluded from the statistical analysis were encouraging. The research questions were answered and results should prove to be a valuable contribution to the mobile learning field.

It was found that there is a strong correlation between IEQ and SIQ scores, which suggests that this measurement can be reliably used for similar studies. Although it is suggested that the SIQ measurement only be used to prove the reliability of the IEQ as was used by Jennett et al. (2008). This is because as a stand-alone measure it lacks the clarity to measure immersion scores consistently.

The results when characteristics and immersion were explored found that video duration has an effect on participants' immersion scores, whereas presentation does not. It was also found that video duration affects both presentation styles differently. For whiteboard videos immersions drops significantly after three minutes, whereas for 'teacher with slides' levels of immersion remain consistent between lengths of 3 and 5 minutes.

Finally when it was explored if there was a relationship between immersion and learning using smartphone devices this was found to be true. There was a correlation between both however its strength was weak. When individual videos were investigated using scatter graphs there was no clear pattern shown in line with a regression line. Further investigation is recommended as there may be other factors in addition to immersion that affect users ability to learn using smartphones.

5. Evaluation, Reflection and Conclusion

This overall aim of this research was to identify ways to improve mobile video learning content, specifically on Smartphone devices. The experimental research was successfully designed and executed, the research hypotheses were answered. This chapter will revisit these research questions, summarise the findings from this study and provide a conclusion and suggestions for future research.

5.1 Project Planning

The project was carried out in line with the study plan submitted (**Appendix B**), with the exception of some minor changes. Originally a between-participants study was planned, however after consideration this was changed to a within-participants approach, as results for each participant could then be examined for all six videos. This added approximately 20 minutes to the original experiment.

The first version of the plan proposed that the experiments be conducted in a lab setting, where the researcher would simulate distractions found in public environments. This was so the researcher had control over the study to avoid any potential surprises that may have been found in public spaces. This was changed due the impracticality of the approach as it was judged that it was more important to test and gain feedback on the video content itself, rather than the mobile experience as a whole.

The 4-weeks set aside for data collection ran according to plan but it occurred two weeks later than planned. This was due to the extra time it took to design the experiment, as suitable content for the video lessons was harder to acquire than first thought. After the experiments were completed due to the steep learning curve, a large amount of time was dedicated to working on the statistical analysis.

5.2 Literature Review

The literature review conducted was comprehensive and covered many aspects of mobile learning such as its definition, potential impact, characteristics related to video learning, engagement, and immersion. Previous literature helped explain why mobile learning has become as popular as it has and where it may be going in the future. However, as a subject area it is still in its infancy and as a result it does have its problems. An example of this is the lack of an agreed upon definition in the field.

These views from the literature were referred to throughout the study and helped inform the design of the experimental study.

5.3 Method

5.3.1 The Lessons

Although the app prototype built for the experiment worked well, sourcing suitable video content proved a lot more challenging.

A compromise was considered for one presentation style where it would be replaced with a slide show with an instructor voiceover, rather than an instructor speaking to the camera. Content could be easily sourced for this style, however the idea was abandoned as the quality levels between the two presentation styles would have been too great. Eventually usable content on a similar subject was found that satisfied both styles. Unfortunately this content was delivered by separate instructors for each style, and each instructor had very strong personalities. Although it was tempting to make do with this approach it would have seriously influenced the results of the study, as naturally viewers would have had a preference to one teacher over the other.

As a solution it was decided to find an instructor who had taught in both styles, and then use video editing software to piece together different lessons to satisfy the study's requirements.

5.3.2 Participant Recruitment

Recruitment for the study was carried out according to plan and in total 26 participants took part. From this number 24 participated in the final study and one was used as the pilot session. As mentioned earlier recruitment may have been much smoother if the study had tried to work with a class in the University. Prior to the study the aim was to get a mixture of both students and working professionals for the experiment, but due to the availability of people, students' times were easier to manage. This also meant that travel for both parties was not an obstacle. Naturally this resulted in more student participants than expected, 14 in total. If such student participation was anticipated, then a University class may have been approached directly.

5.3.3 Experiment Procedure

A worry about the experiment was that it would run considerably over time. Participants were told previous to the study would last anywhere from 1 hour 20 minutes and upward. Due to the amount of material and testing that was conduced in the session, time management could easily spiral out of control. This meant that the researcher had to try facilitate the participant through the process in a prompt fashion. This wasn't always easy as when new people are met for the first time, the natural instinct is always to take some time to get to know them.

Some of the questions asked in the background questionnaire weren't used in the final study planned. It was thought that some further data analysis could be conducted related to questionnaire answers such as gender, age and smartphone usage. These factors could not be analysed in any great detail, as the literature review didn't support the reasons for it. This is

commonly known as 'fishing' and effort was made to avoid it. Despite this, to satisfy the researchers curiosity statistical tests were conducted between gender to see if there was any significant difference in immersion and exam scores. Unsurprisingly no significant difference was found.

As part of the study a better examination marking criteria could have been created. The exam was very much based on facts that students could remember from the lesson. As it was impossible to remember everything students results were low in general. The exam criteria may have indirectly affected our second research question in relation to the correlation between engagement and learning. Learning is seen as more than just regurgitation of facts, therefore participants could possibly have been awarded marks for their own thinking towards the content.

Post study unnecessary time was dedicated to the observation of participant video recordings from the session. This was to investigate if any physical mannerisms showed signs of fatigue, boredom or any other sign of disengagement. Attempts were made to draw patterns from this, however the analysis was soon abandoned after it was judged there was nothing of value to report. The one thing of note was that for the longer videos, a number of participants touched the screen to see how long was remaining.

A pilot study informed the experimental procedure and resulted in some changes being made to the structure of tasks. The most notable was the change in the order of the post-lesson exam. Previous to the pilot session the exam was taken after the IEQ, however from feedback it was judged that it would be more suitable if conducted before the IEQ.

5.4 Data Collection & Analysis

A vast amount of data was recorded for the study. For each of 24 participants, six separate 31-question IEQ's had to be calculated and recorded in spreadsheets. From this data the scores for 5 immersion factors were totalled, by adding results for specific sets of questions. The single immersion question scores were also recorded.

Although the recording of this data took up a lot of time, there was no real alternative to speed up the process. Involving further technology in the experiment may have added unnecessary confusion to participants. What was noticeable was there was a lot of paperwork involved in the study. Perhaps an online questionnaire could have been utilised for the IEQ.

5.5 Summary of Findings

The main conclusion that can be drawn from this research is that participants from the study enjoyed the experience of watching video lessons on a Smartphone. Some comments made were: "I think a smaller screen is better in some ways as you feel attached" and the Smartphone "influenced my ability to learn in a positive way, not a negative way". This gives a positive reflection mobile video learning and shows that for students it is seen as a natural way to learn.

We will look to summarise our results in relation to the study's research questions.

The first question was:

What characteristics of educational videos on Smartphone devices make them more engaging to users?

The first result of the study was there is a very strong correlation ($r = .835$, $p < .001$) between IEQ and SIQ scores. This proves that for mobile video learning the IEQ is an accurate reflection of participant's immersion. At face value it may suggest that for future studies one may be used without the other. This was deemed not to be the case as there were some differences of significance between pairs of videos for the two measures. The single immersion question may be too simplistic to assess a participant's level of immersion for one video. After all it is only one question answered on a scale of 1-10.

A second finding was that length has an effect on participant's immersion scores, whereas presentation style does not. This was reflected in participant's qualitative data where longer videos were described as "information overload" and "quite draining". This result is supported by the literature review and suggests that video length should seriously be considered when creating mobile video content. It was found that for participant exam results, presentation style showed no significant difference in scores, whereas video duration did. For immersion scores when explored further we found that for whiteboard animations there appears to be a point between 3 and 5 minutes where immersion levels drop significantly, whereas between 5 and 10 minutes there was no significant difference. An alternative result was found for 'teacher with slides' style where there was little difference in immersion between 3 and 5 minutes videos, but after the 5 minute mark levels dropped greatly. This result suggests that 'teacher with slides' videos keeps students immersed for longer periods of time.

The second research question from the study was:

What is the effect of engagement on learning using Smartphone devices?

It was found that there was a significant relationship between immersion and participant exam scores; however, this correlation was lower than expected. Separate tests ran show similar strengths of correlation when compared to exam scores for both IEQ ($r = .210$) and SIQ ($r = .215$). When the results were plotted on a scatter graph the results did not appear to correlate very strongly with one another. The conclusion was that when using smartphones engagement is related to learning somewhat, but there may be more that influences participant's ability to learn than engagement alone.

5.6 Further Research

In relation to this study's second research question results show that engagement does affect learning, but that there needs to be other factors accounted for. Future research could explore this by testing different psychological measures in viewing mobile videos. This could perhaps contribute to a new definition of engagement in relation to mobile video learning. It could also potentially influence a new measure of engagement in this context.

Although the IEQ was used to good effect it still is a questionnaire that was originally created for video gaming. From its use it was found that some elements of the 'control' factor didn't quite apply to mobile video learning. Therefore it is recommended that research be conducted to create a bespoke immersion experience questionnaire influenced by work conducted by Jennett, for mobile video learning.

Mobile usage can be seen from two perspectives. O'Hara et al (2007: 859) observed incidences of solitary mobile video usage, which were not in the expected mobile environment but in the workplace or home. This research has addressed this type of mobile video usage in relation to learning. A suggestion for future research would be to test the same content, but in different public environments. It would also be interesting to learn if users perform differently depending on their physical posture. Do participants learning more sitting down than standing up?

5.7 Self Reflection

This study proved a challenging but enjoyable experience. Previous to this the researcher had never carried out a user-based study to this extent, nor worked with this amount of data. As a result many new skills were developed.

On reflection there may be elements of this study that the researcher would change. The testing session felt very long and from the users perspective it was possibly too demanding. Some participants reacted well and seemed to embrace the experience, however for a handful that were less engaged, it may have seemed like hard work. The general feedback on mobile video learning itself was extremely positive but there was a lot of paperwork. For the purpose of the research these details seemed necessary, but perhaps the study could have been changed slightly to shorten the experience for users. An example of this may have been to test shorter video lengths.

It was also discovered that attention to detail when conducting an experimental study is essential. As a lot of paperwork had to be managed and a number of backups were always at hand to prevent any hiccups. The researchers script also helped greatly in ensuring that no part of the experiment was missed. Audio recording interviews was also very valuable and these could be explored in more detail at a later date.

In the study a lot of time was spent on the statistical analysis, which for the researcher was found to be challenging. It was easy to get 'bogged' down in problems specific to one area of the study, whereas over time it was found more valuable to concentrate on another section and return to the original problem at a later time.

The subject of the study is one that the researcher is particularly passionate about. As a result there were small and possibly non-essential parts of the study that the researcher may have spent too much time on. This is where the supervisor's input was vital. Ironically the more 'immersed' the researcher became in the subject, the harder it was to step back and observe the 'bigger picture'. Over time it was learned to always think of the original project objectives when justifying a new part of the study.

5.8 Conclusion

The purpose of this study was to contribute research of value to the mobile learning field. Overall the results uncovered from this work are seen as a success.

This project has found that when using Smartphone's for learning, video duration affects participant's engagement levels. When two presentation styles were tested to see if they also had the same effect, this proved not to be the case. Therefore it is seen that from the two characteristics tested, video duration is the most important in terms of user engagement and should be considered most when creating content. The work has also successfully shown that using Smartphone's, user engagement does have an affect on participants' ability to learn however, this correlation was not as strong as originally hoped.

As part of this study a new measure of engagement in terms of immersion was found and put to good use for mobile video learning. This measurement is one that can be used by researchers conducting similar studies in the future, however time should be taken to create a questionnaire specific to mobile learning. Also time should be taken to construct a theoretically sound definition of mobile learning that will be satisfactory to the both the technology and teaching communities.

There are a number of opportunities for further research related to this project. The natural progression would be to conduct a similar study in 'real world' mobile environments. As smartphones are used in public settings as well as in private spaces during downtime, this could result in two different forms of teaching content provided for students. The first learners could utilise when tight on time, and the second could be used when more time and privacy is available that supports a greater degree of detail. This may even influence how module content is organised on mobile devices. Only when these environmental contexts are explored we will begin to understand m-learning in greater detail.

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7. Appendices

Appendix A – Project Proposal for MSc in Human-Centred Systems

Research Proposal:	**'On the move': Investigating engagement related to mobile learning.**
Prepared for:	**Jason Dykes**
Supervisor:	**Dr. Simone Stumpf**
Prepared by:	**Eoin O Donnell**

Introduction

'On the move': Investigating engagement related to mobile learning.

Today there are currently 1.2 billion mobile web users worldwide. In an increasingly busy world where people are constantly on the move, we are seeing mobile beginning to take over from traditional Internet usage. In support of this growth the Consumer Tablet Forecast Update 2013-2017 (Virtual College, 2013), has estimated that circa 1 billion people across the world will own tablets by 2017 (up from 380 million in 2013). Businesses such as Facebook are repositioning their whole strategy around mobile, with users now engaging twice as much using smartphones and tablets (in page views, interaction, consumption and production) than desktop or laptop users. We have also seen a recent resurgence within the e-learning space with suppliers such as Coursera attracting more than 4 million student signups. As Carson Kahn (an education technology specialist at the City University of New York) puts it, "education lags 30 years behind most of the world, and 50 years behind Silicon Valley". Recent technologies such as mobile video lectures, online discussion boards, automated grading algorithms and virtual labs are in their infancy, and will only improve in quality.

As mobile Internet usage is now integrated into our daily lives, where each of us has access to a vast amount of information at any given time, it is important that we investigate how we interact with this technology in its own right. Learning is now more accessible than ever and its effectiveness is not only dependent on improvements in mobile hardware, Internet speeds and app development, but also on the way in which we communicate teaching content. In the traditional classroom how content is taught is key to students ability to learn. This should be no different on mobile. With this in mind our project will investigate learning on mobile devices focusing on teaching content and how we can tailor this video content to improve the effectiveness of student mobile learning. We will look at the effect that engagement has on mobile learning and how it can increase students potential to learn. An evaluation will be conducted to observe a user group's experience of learning using mobile technology. Alternative video features will be tested such as content and video length, to assess user engagement levels. Our research will determine if engagement can be linked to learning on mobile devices, and the results that emerge from our study will contribute to and set of guidelines for producing video learning content on mobile.

Aims and Objectives

The aim of this research is to provide a better understanding of video learning within the mobile space, and to identify how we can improve students learning experience.

We will look to answer following research questions:

- What characteristics of educational videos on mobile devices make these videos more engaging to users?
- What is the effect of engagement on learning using mobile devices?

- To review current literature to build a better knowledge of students usage of e-learning, mobile learning, and general mobile habits (with a particular focus on mobile video in other domains).
- To collect qualitative and quantitative data through user interviews and questionnaires to assess attitudes and opinions towards mobile learning. We will also explore general mobile and e-learning usage.
- To discover what an engaging mobile learning experience is, by conducting a usability study to determine what effect changes in video content and features have on user engagement.

The main output of this research project will be this set of guidelines. The author of this work is currently building a piece of mobile learning software unrelated to this project; however, the results from this research will heavily influence the type of video content that is used on this platform. Other beneficiaries from this project will include researchers and designers within the technology learning space, as well as the student learners themselves.

Scope and definition

We will be focusing specifically on the mobile space, conducting all usability testing on mobile devices in lab settings. The main scope of this research is to produce a report providing a set of guidelines, with the strategic aim of improving the student mobile learning experience as a whole. We will be focusing on features that a mobile learning video should include, to provide an engaging class with memorable content. Lalmas at al. (2012) describe engagement as "the quality of the user experience that emphasis's the positive aspects of the interaction, and in particular the phenomena associated with being captivated by a web application, and so being motivated to use it." We agree with this statement but rather than focus on applications specifically, we will instead be exploring different forms of teaching content which include: teachers speaking directly to a camera communicating learning content (similar to a face to face environment), video classes which use Powerpoint slides with voice over to communicate learning content, videos that use a combination of both, and newer video teaching styles such as the use of Livescribe enabling teachers handwritten notes to appear on screen in real time, alongside their commentary. We will be looking to test these different forms of content across a variety of subjects with relevant user groups. We will also test various lengths of video mobile content in our study.

The types of mobile devices we will be investigating will include smartphones such as the iPhone, the Samsung Galaxy and the Google Nexus and our maximum dimensions will be 5.59 in x 2.85 in (the size of the Samsung Galaxy S5). We have decided not to use tablet devices in our study for reasons which we explain in our methodology. The author has built a piece of mobile learning software for IOS and Android smartphone devices which we will use to test our content. This

mobile platform host's video learning content for students to view. Content is split into modules, much like a University curriculum, and then sorted by weeks. Video classes can be synced to the users smartphone, meaning that content that can be viewed 'on the move' without Internet connection. This eliminates troublesome factors such as buffering and video quality, which can affect the users experience. As a result learning content can be viewed in environments such as the London Underground. Although this platform has the capability for classmates to interact with one another, we will be focusing on the students experience with the content alone.

This piece of research will help us to transform our findings into a functioning long-term service. Future plans have been made to pilot this software with an employer, focusing on learning content of interest to their employees. In the long term we are planning a full scale incremental roll out, targeting professional users within SME's (small to medium-sized enterprises). Our results and recommendations from this project will be implemented into this new mobile learning system.

Critical Context & Literature review

Although there have been previous studies on levels of learner engagement both in the classroom and on desktop e-learning platforms, there has yet to be a study which looks specifically at students engagement levels in relation to video learning on mobile devices. In addition, there has been no research conducted that involves a usability study that experiments with different forms of mobile video learning content, to construct a set of guidelines.

Mobile learning and the future

There is no doubt that mobile learning will play a pivotal role in the future of education, not only complementing face-to-face and desktop learning, but also as a stand alone learning platform in itself. A common optimism is shared in previous e-learning research, where the opportunities that these new and exciting learning technologies present are discussed. According to Zhang et al. (2006: 17) some of the benefits of e-learning are that it:

- Provides time and location flexibility
- Results in cost and time savings for educational institutions
- Fosters self-directed and self paced learning by enabling learner centred activities
- Allows unlimited access to learning material
- And allows knowledge to be updated and maintained in a more timely manner.

In a mobile context Evans (2008) elaborates on this further stating that the use of portable technologies makes it easier for learners to study when and where they want, as users can easily transport learning materials. This Evans (2008: 492) says encourages "just-in-time learning" which are periods of unexpected free time that learners can take advantage of. Other advantages that we would add to this list are: reduced costs for learners which opens up educational opportunities to those who previously could not afford it, unlimited access to the best teachers worldwide, and an opportunity to connect with other classmates globally who are on the same student journey. The timing of this piece of research is particularly appropriate as Coursera have recently launched their mobile app in March 2014 and other MOOC (massive open online course) providers are expected to follow suit.

Desktop e-learning & effectiveness

Previous studies such as Zhang et al. (2006) focus on the impact of desktop interactive video on e-learning effectiveness, through a study involving four different learning settings. Zhang et al. (2006: 16) classify 'interactive' video as a multimedia based e-learning system which simultaneously includes video lectures, Powerpoint slides and lecture notes, and that gives users the control to access individual video segments directly. The alternative settings explored in this study were variations of this interactive video, as well as live face-to-face classes. Zhang et al. (2006) argue that learners who play an active rather than passive role to discover content for themselves, can help motivate their learning therefore improving learning effectiveness. Evans (2008: 493) agrees stating, "well-designed virtual learning materials, by increasing the amount of control learners have over the learning process, can be more efficient and effective than traditional alternatives". Zhang et al (2006) go on to say that the problem with most instructional video is that there has been a lack of interactivity, where users are unable to directly jump to a particular part of the video. Zhang et al. (2006: 17) (in Marchionini, 2003: 36-41) agree that "having video in small chunks that are well-indexed, and easily manipulated and incorporated into lessons is the first step to realising its potential". We agree with these viewpoints and have taken them into consideration in our study. The mobile learning software which we have built provides users with bite-sized pieces of mobile video content, and gives users the freedom to navigate through the materials at their own pace. Although Zhang et al. (2006) prove that in some circumstances stand alone interactive e-learning can be more effective than other methods, and Evans (2008) shows that the use of podcasts for revision purposes can add value, both are more concerned with the medium of delivery and the users ability to control the pace of learning. They fail to recognise other important factors such as the teaching content being communicated. Both also focus on 'learning effectiveness' rather than 'user engagement' and provide no recommendations on what makes for engaging learning content. In this study we plan to answer this important question.

'Engagement' and learning

Priego & Peralta (2013) attempt to identify motivational factors associated with e-learning and clarify which learning products are more suitable in helping users gain good quality knowledge. They refer to e-learning 'engagement' as 'awakening learners curiosity', but fail to define what e-learning engagement really is. This is a vague definition and it is for this reason that we have omitted this work from our analysis. Robinson & Hullinger (2008) discuss 'engagement' more effectively as they attempt to measure student engagement in three online University courses, using the National Survey of Student Engagement (NSSE). This measure focuses on the quality of the overall educational experience and measures what the students do with the learning resources available to them. Although this study focuses on other forms of learning such as text based learning, the results are encouraging with online students reporting higher levels of engagement than on-campus students, across four measured benchmarks. In our research we will refer to the National Survey of Student Engagement when considering our mobile video content's engagement levels. Robinson & Hullinger (2008: 101) also succeed in differentiating between learning 'effectiveness' and learning 'engagement'. They proclaim that the evaluation of online learning needs to go beyond measures of 'effectiveness' and to consider the quality of the learning experience as a whole. Lalmas et al. (2012) speak about engagement on a more personal level where users "invest time, attention, and emotion". Robinson & Hullinger (2008: 101) (in Kuh, 2003) state "engagement pertains to the efforts of the student to study a subject, practice, obtain feedback, analyse and solve problems". Unlike previous studies by Zhang et al. (2006) and Evans

(2008), we will look to concentrate on 'user engagement' linking it to learning 'effectiveness'.

Anderson et al. (2014) is an interesting reference point with regards to the new phenomena of 'Massive Open Online Courses'; however, it's a paper that is more concerned with studying students engagement with MOOC website features and classmates, rather than exploring what makes for engaging video content. They look at elements such as the use of badges as incentives to increase student engagement levels. Although the study is interesting, this is a very different area of engagement to what we are looking at. What is particularly interesting about their study is that they pose a question in relation to MOOC student drop out rates, which traditionally have been high. They ask: do students enrol on a MOOC for the same reasons they do for a face-to-face course? And if not, is it possible that for some users, MOOC's are really used as a study reference point rather than a curriculum to be completed? (Anderson et al, 2014: 687). With regards to our research this may be a question worth asking our participants. As if their motivations for taking a mobile course are not the same as their motivation for taking a course in a classroom, then should we be looking towards a new style of teaching to increase engagement levels in relation to user motivations?

Mobile vs. Desktop

Until now the majority of research has concentrated on either desktop e-learning and engagement:

1. Priego, R. and Peralta, A. (2013), who attempt to identify engagement and motivation factors in e-learning,
2. Anderson, A. et al (2014), who look at engagement levels concerned with Massive Online Courses,
3. Robinson, C. and Hullinger, H. (2008), who measure student engagement in 3 online University courses,

OR desktop e-learning and effectiveness:

1. Zhang et al. (2006), who look at the impact that interactive video has on learning effectiveness,
2. Evans, C. (2008), who explore the effectiveness that podcast revision lectures have in education.

A gap in the research exists as engagement and effectiveness have been looked at in desktop e-learning environments, but they have not been explored in a mobile context. As a result of this limited research, engagement in relation to mobile technology and learning is relatively unknown. Elements unassociated with traditional desktop e-learning such as screen size, surrounding environments and concentration levels, are factors that need to be taken into consideration. This project will go one stage further than just exploring mobile 'engagement', we will make recommendations on how to make mobile video classes more 'engaging'.

As part of Evans (2008) study, he briefly touched on users that had viewed lecture podcasts on mobile devices such as previous generation iPod's, iPhone's and Blackberry's. 25% of participants surveyed said that they had listened to the podcasts on their mobile device while travelling. As Evans research objectives were more concerned with the effectiveness of podcasts in supporting revision, he didn't explore this 25% of users in more detail. Also in his measurements Evans was more concerned with users opinions on whether podcasts added value to the revision process, rather than testing if the podcast had an effect on what they had actually learnt independent of

textbooks and notes. We believe that the total of 25% would have been much higher if users did not have the extra step of downloading content first to their computer, and then to their mobile device. As technologies such as mobile hardware, cloud storage, and mobile apps have improved significantly since 2008 and are now more accessible to a much wider audience, we believe that this is an area worth readdressing.

Exploring video usage on mobile

In Balachandran et al. (2013: 339) they discuss how our understanding of Internet video 'quality of experience' (QOE) is very limited. Considering the amount of money that is invested in online advertising we find this quite surprising. Rather than focus specifically on video content they explore video engagement from a more technical point of view, considering metrics such as rate of buffering, join time and bitrates. They also look at the number of visits and viewing times discussing 'early quitters' and their motivations behind video usage. What perhaps is more relevant is exploring how mobile video is being integrated into peoples lives as is studied by O'Hara et al. (2007) in 'Consuming Video On Mobile Devices'. What was interesting from their study (albeit their analysis was regarding mobile video for entertainment purposes) was that they found that mobile video was consumed in a variety of places such as buses, cars, trains, work cafeterias and office desks. O'Hara et al. (2007) also confirm previous research (in Södergård, 2003) which suggests that user viewing times on mobile devices were particularly shorter. They discovered that one of the main reasons for not watching for long periods of time on mobile was the small screen size. When we consider the ideal length for a mobile learning video as part of our research, these findings will be referred to. According to O'Hara et al. (2007: 859) "for some users on lunch being immersed in the audio-visual experience of mobile video allowed them to claim back their own time and space, blocking out sights and sounds of a shared workspace". This is an interesting motivating factor which could be applied to users learning habits. As part of this project we will need to investigate further how mobile video and learning can be better integrated into peoples daily lives.

Project purpose & output

Although our study is unique in its approach it has been informed by research from a variety of areas. Further analysis of what learning engagement really is, combined with deeper research into video usage on mobile, is key to informing our work. The benefits of this project will be that it will provide a unique insight into this new form of learning that is relatively unexplored. Overall there is little (if any) research that looks at not only students ability to learn using a multimedia mobile device, but that also develops a set of guidelines for teachers to present their work more effectively.

Methodology

The focus of our methodology will be to answer two research questions:

- What characteristics of educational videos on mobile devices make these videos more engaging to users?
- What is the effect of engagement on learning using mobile devices?

As part of this study we will be testing four different types of video teaching content:

1. Teachers who speak directly to the camera communicating learning content,
2. Powerpoint slides accompanied by teacher voice over to communicate learning content,

3. A combination of both (a teacher speaking to the camera with the visual use of Powerpoint slides),
4. An alternative teaching style using Livescribe which enables teachers handwritten notes to appear on screen in real time, combined with teacher commentary.

We will also look to assess various video lengths throughout our research. For this study we have already been successful in sourcing video content for intermediate level subjects such as typography and programming, and a beginners level class on Video SEO and Marketing. Although it is tempting to conduct our testing in real world environments, we have decided against it for a number of reasons. Our main reason is that it is very difficult to assess if users learning is affected by the features of the mobile video content, or if it is really affected by the public environment that they are in. No one would argue that trying to learn on a crowded London tube during rush hour is somewhat different to studying sitting down on an empty train. As researchers we are unable to observe participants usage 'in the wild', so it would be hard to decipher the effect that the surrounding environment would have on our data. We would be relying on participant's feedback and their recall of the environment from a number of days previous. An alternative could be to split our testing between real world and lab environments; however, it would be difficult to compare these two sets of results, as they are in completely different contexts. Instead we will conduct our testing in a lab setting where we can mimic a public environment. This way we have control of potential user distractions, which we can use to test participants ability to concentrate on content. Also by working with users in a lab setting, we have much more control over the interview, questionnaire and content examination process. With users in a public environment we'd be reliant on the participants to firstly view the videos in their own time as requested, secondly report back for interview and examination, and thirdly be able to remember their experience days later.

With this in mind we will be looking to test 18 participants in a lab environment. There are a number of questions we want to answer in our testing. We want to know if one of our four forms of video teaching is more engaging than the others, and if so does it increase our participants learning effectiveness? Secondly we want to find out if the length of video content on mobile devices has an effect on engagement levels? We plan to obtain this information through observations, measurements of engagement, interviews and content examinations. For our participant group of 18 we plan to work with both University students and working professionals ideally aiming for a 50/50 split between each. Likewise we want a fair representation of both male a female participants, with varying experiences of mobile technology across a wide age range. Our user groups will be largely influenced by the type of content we source, as it is important that participant's have the capability and necessary knowledge to understand new content in that domain. As mentioned previously, we have already begun this process. On testing day, participants will be given brief training on the mobile application prior to use, after which testing will occur. Once the study is completed our users will be rewarded with a small incentive for their time.

We want to bring three groups of 6 participants into the lab for testing, over three separate days. For this study we will be working specifically with smartphones. Similar to public environments working with both smartphone and table devices was tempting, but we don't want the technology to inform the users learning experience. After all we are trying to test the teaching content, not the device. We believe that what makes for interesting content on a smartphone device will make

for interesting content on a larger tablet. Also smartphone usage is more common, so its use is a better representation of the public. In our study each participants engagement levels will be tested as they view two alternative forms of video content, on two different topics. After this they will be asked to take a content examination on both, to test their learning effectiveness. Throughout the testing experience we will mimic various environments such as being on the London Underground, waiting at a local bus stop, or sitting at their work desk on their lunch break, to test how users react to distraction. Various lengths of video content will be tested throughout this process. We think that it is beneficial for our users to be tested across two forms of comparative content as one can act as a benchmark, which we can analyse the others performance against. Using these methods we will make full use of our user groups participation, with 36 test reports generated in total, spread across four alternative teaching formats.

We will observe and measure user engagement is two ways. Lalmas et al. (2012: 165) divide user engagement measures into three groups "self-reported engagement, cognitive engagement, and online behaviour metrics". For this study we will concentrate on self-reported engagement and cognitive engagement, as online behaviour metrics are not relevant to our study. We will use questionnaires and interviews with our participants on the day of testing, for users to self-report their engagement levels. As we're working with a user group of 18, we hope to avoid the drawbacks mentioned by Lalmas et al. (2012) related to user subjectivity. We will also try to encourage open discussion amongst our group. We plan to measure cognitive engagement by giving participants follow-on tasks after they interact with each video class, which will include a short examination to measure their memory of the content. Users engagement levels will be considered when analysing their performance in their examinations for each piece of content. As we will be working with a small number of users in a lab environment, we can observe participants physiological measures when viewing video content, to assess their levels of engagement. Examples of this are measuring facial movements, heart rate and tracking eye movement.

Throughout testing we will capture both qualitative and quantitative data using methods such as questionnaires and interviews. The types of quantitative data we will capture will be user age, user examination scores (for two subjects), user scores in relation to video length, user physiological measures such as heart rate, physical postures and attention, the time users are in eye contact with the screen, user play and pause times, as well as quantitative data associated with questionnaires such as likert scales and preference ratings. The types of qualitative data we will be looking to capture will be users opinion towards mobile learning prior to testing, their previous experience with desktop e-learning (if any), information on their current mobile habits, user feedback on their mobile video testing experience (post-test), our observations and video analysis, how effective users perceive their mobile video learning experience to be, and how engaging users found the video content and length. One week prior to testing participants will be assigned a pre-test questionnaire which will capture some of this data. They will be required to take a brief multiple-choice assessment, to ensure that they have no knowledge of the content prior to the video testing.

Once our data is gathered it will need to be analysed using computer-aided tools. To assist in our quantitative analysis we will use the tool SPSS to input, record, code and make comparisons of our data. We will use NVivo for our qualitative analysis to record text and multimedia information helping us code, sort and arrange our data, examining relationships uncovered in our results. We will also use other common tools such as Microsoft Word, Excel and iMovie to record and analyse

findings. From our analysis we want to discover the relevance of our findings in relation to previous research. When analysing our data we will first look to compare user examination scores for our 18 participants, to each form of teaching content. This will reveal which type of video content has most influence on student learning effectiveness. We will also look at user examination scores in comparison to video length, to see if there is a correlation between user attention levels and examination performance. We are very interested to find out how shorter video classes perform against longer content. Measurements such as mean, median, range and standard deviation will be calculated for each set of examination results, related to each form of content. This will give us an excellent overview of content performance. Visual aids such as tables, bar charts and scatter graphs will be developed from this data to better communicate our analysis. As well as learning effectiveness we will also look to measure our user engagement data, such as physiological figures, with our user examination scores. This may reveal if user engagement on mobile devices has a direct influence on mobile learning effectiveness. Qualitative data will be studied such as user opinions, and will be measured against our quantitative data for consistency. All of our data will be coded to categorise our evidence, and a thematic analysis will be conducted to identify important themes in our data. From our qualitative data we are keen to discover the length of time that it takes users to begin to disengage with video content. This information will come from studying user behaviours and posture, which we will have recorded using a video camera. With our qualitative data we will look to examine if users attitudes towards mobile learning prior to testing (recorded in questionnaires and interviews), affected their engagement levels and therefore performance during testing. From our analysis of qualitative and quantitative data we will arrive at an end set of reliable results. These results will inform our user guidelines and help us make recommendations in our final report

Alongside testing sessions, other elements of our process will include:

- Analysis of desktop e-learning metrics for platforms such as Coursera, EdX and Udemy. Online publications will provide valuable background to student engagement levels and e-learning systems.
- Sourcing suitable video content to test with our three user groups.
- Developing pre and post test questionnaires, user interviews and examinations.
- Participant recruitment.
- And development of final conclusions and guidelines

Throughout our three testing sessions the author will liaise regularly with his supervisor to evaluate methods, monitor progress and make alterations where needed.

Ethical legal and professional issues

We have considered all legal and professional issues and have included in our appendices a completed copy of the Research Ethics Checklist. This piece of research does not pose any risks to any of our participants. Consent will be gained from each individual (please find an adult consent request form in the appendices), with a full explanation of our project intentions in the form of an information sheet (also found in our appendices). All participants will be aged 18 years or over and will be made aware that they can withdraw from the study at any time. We have no reason for information disclosing the identification of any participants to be published in our final project and all information obtained regarding participants will be dealt with in a confidential and ethical

manner. Personal information will not be disclosed to any third parties and there are no businesses involved in our study that need identifying. There are no ethical issues in our study that violate the Research Ethics Policy, version 2 (06/10/2011).

Work plan

Gantt chart

Task	June 1-8	June 9-15	June 16-22	June 23-30	July 1-8	July 9-15	July 16-22	July 23-31	Aug 1-7	Aug 8-14	Aug 15-21	Aug 22-31
Submit dissertation proposal												
Conduct literature review												
Research desktop e-learning data												
Source mobile testing content												
Identify participants for study												
Develop phase 1, 2& 3 pre & post test questionnaires / interviews												
Phase 1 lab testing												
Analysis of phase 1 data												
Phase 2 lab testing												
Analysis of phase 2 data												
Phase 3 lab testing												

Task	Sept 1-8	Sept 9-15	Sept 16-22	Sept 23-30	Oct 1-8	Oct 9-15	Oct 16-22	Oct 23-31	Nov 1-8	Nov 9-15	Nov 16-22	Nov 23-30
Analysis of phase 3 data												
Compare phase 1, 2 & 3 data												
Write up findings and conclusions												

Complete set of guidelines												
Submit draft to supervisor												

Task	Dec 1-8	Dec 9-15	Dec 16-22	Dec 23-31	Jan 1-8	Jan 9-15	Jan 16-22	Jan 23-31
Revise draft and complete								
Submit final dissertation								

Risks

Risk #	Risk Statement	Probability	Impact	Action to prevent / mitigate risk
1	**Video content**: Problems gathering appropriate video content for testing. Content will have to be of good quality and relevant to the user group or at a beginners level.	**Low**	**High**: Our content will distinguish if engagement is related to learning on mobile devices, and will help identify what makes for an engaging mobile learning experience.	If problems are encountered this could delay the project. To prevent this we have already began to source quality content from external providers. If however the nature of our final content is not suited to our testing, we will focus solely on beginners content.
2	**Participants**: There are risks associated with sourcing the appropriate number of participants (18) for our usability evaluation.	**Low**	**Medium**: Recruiting participants is always a challenge. Failing to recruit 18 will effect, but not damage our research.	Family and friends have expressed interest in participating in this research project. We have access to a number of student participants through the University, and we will also make effective use of the network meetup.com, which includes various professional interest groups.

3	**Platform**: There is a possibility that our platform will encounter technical problems.	**Low**	**Low**: The purpose of the research is to test the content for engagement rather than the platform it is being tested on.	The prototype of the platform has already been developed and appears to stable in hosting video content. If problems do occur we can test our content on alternative platforms such as Youtube or Vimeo.
4	**Time**: The author will be running a start-up business full-time alongside this piece of research, therefore there is a risk of mis-management of time.	**Low**	**High:** Appropriate time needs to be dedicated to this project for the research to be conducted thoroughly.	Time constraints will be managed effectively through pre-planning. This research is directly related to the authors start-up project, therefore the findings from this work will help it become a success. With planning and discipline this research will be completed in time.
5	**Delays:** There is an element of risk throughout the project that there will be delays in gathering the content in time, or gathering the right level of data required to move to the next stage of research.	**Medium**	**High**: This potentially has serious repercussions to the project as a failure to hit individual milestones will have a knock on effect with future objectives.	We plan to conduct the time sensitive elements of the project such as usability testing, as early as possible in our process. The project will be time focused and will stick to our 8 month work plan. Quality of data gathered will be assessed as soon as possible after testing. We have also provided a buffer period of 5 weeks in our work plan for unforeseen delays.
6	**User awareness:** Users will have read and signed our consent form and participant information sheet. As they know that they will tested after the session, this may influence	**Medium**	**Low:** Although this may influence results with some users, it should have little effect on our overall study. In any piece of research this is unavoidable due to participant consent	As this is unavoidable, how our participants answer their questions on content knowledge (prior to the study) will have to be monitored closely. If the post test examination is deemed to be too easy, we will adjust the content accordingly, possibly asking

	how they approach the learning video content.		requirements.	participants to apply a piece of knowledge they've learnt to a particular scenario.

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Appendix B – Study Plan

Research Questions

Q.1 What characteristics of educational videos on mobile devices (such as presentation style and length), makes them more engaging to users?

Q.2 What is the effect of engagement on learning using mobile devices?

Overview of the study

From this study we aim to provide a better understanding of video learning using a mobile device with a focus on Smartphone's. We will look at two important elements of video learning: the presentation style and the length of video educational content. We're interested in both of these factors, as they have not been researched before. As mobile devices and online learning are becoming more prominent, we feel that this is an important issue, which needs to be addressed. We will combine two of the most common presentation styles to one, which will be a teacher talking to camera accompanied by a PowerPoint presentation. Video whiteboard animation is a new and novel way to tell a story alongside audio, which is not commonly used but becoming more popular. For educational purposes we want to find out how whiteboard animations compare to the traditional PowerPoint with teacher format.

Also when it comes to educational video content, no one knows the optimum length for mobile devices. We want to experiment with three different video lengths (3/5/10 min) and the effects that each has on engagement levels. We will explore the effect that changes to both presentation styles and video lengths has on users engagement levels, and then correlate the results with the users learning scores. We will use a number of tried methods from previous research to measure engagement and learning. For this study we a not concerned with the environmental context of the user and we expect our users to learn while sitting in a quiet environment. The reason being due to limited time, to simulate all possible environmental contexts with 24 different users would be impossible. This time is better spent concentrating on both presentation styles and video length.

Participants

We will be testing with 24 participants. In total we're interested in 6 formats (2 different presentation styles and 3 different video lengths). The majority of our participants will be University students but we will also test with working professionals to get a larger age distribution. We typically expect our age range to be between 18-50. As gender will not be a telling factor in our study, this will not be considered. Due to the nature of the testing we will need to screen any participants with hearing or visual impairments as this may affect their performance. Other participants screened will be those who have previous knowledge of the teaching subject matter. Our teaching content will be at beginner's level which participants will have no previous knowledge of. We will also try to choose participants from a similar intellectual background, so we have a consistent level of learning ability.

Materials needed

- email advertisement for participants
- background questionnaire
- consent forms
- study script
- video classes and formats
- smartphone with app and good quality headphones (use their own for comfort if possible)
- post video engagement questionnaire for video times
- post video engagement questionnaire for presentation styles
- post video learning test (6 different tests)
- spreadsheet to record results
- incentive for participation

Outline of testing procedure

Testing will be conducted through 24 individual sessions. I will sit with each user while they go through the teaching content and testing session. The reason that we decided not to conduct the testing in-group sessions is because participants could become intimidated or distracted by others partaking in the study. As our focus in not concerned with the physical environment around the user, these testing sessions will be conducted in quiet areas with the user in a seated position.

We will concentrate on one generalist teaching subject such as (Photography, Diet and Nutrition, Beginners language, Technology & Design, UX, Typography) which will be taught at beginners level. There will be six video clips in total on the same subject area. Each participant will have no experience in the chosen subject. Prior to the testing session the participant will be emailed a background questionnaire. This will explore their knowledge of the subject matter, their experience with technology, and other factors that may affect their results.

On testing day the participant will sign their informed consent form and will be given a study script with an overview of what the testing will involve. Participants will then be given training on the mobile app to be used, after which they will be required to watch a series of classes. We will work with smartphones and no other devices. The user will be provided with an iPhone 5, on which has the downloaded app to save on time, and they will be given the option to either a set of headphone provided or their own if it is more comfortable to do so.

Twelve users will watch one style of presentation content, and they will be asked to watch three videos lengths of 3 minutes, 5 minutes & 10 minutes. After each individual video they will be required to complete an engagement questionnaire and an examination to test their knowledge of the subject. The remaining 12 participants will watch two different presentation styles. Firstly they will watch two of the video teacher and PowerPoint presentation styles, and then two of the video whiteboard animation style. After they have watched all assigned videos they will be required to complete an engagement questionnaire and then take a test to see what they have learned.

We decided against using the thinkaloud method as we think it's important that participants are concentrating fully on the new content and not reacting to the old. We will however record notable comments that participants make.

Lalmas et al divide user engagement levels into two groups: self reported engagement and cognitive development. To measure engagement we will concentrate on these two areas. Questionnaires will provide feedback on self reported engagement and cognitive engagement will be measured by a questionnaire put in place. (Now the IEQ). Users will be asked various questions on their engagement (immersion) levels, which will each be measured on a scale of 1-5. We will also measure the users learning from each video. If users scored highly on the engagement grading and high on the learning test then we can prove our research question 'what is the effect of engagement on learning using mobile devices'. The data gathered from our first questionnaire will be both qualitative and quantitative. From analysing the data gathered from our engagement questionnaire we should also be able to answer research question 1: 'What characteristics of educational videos on mobile devices (such as presentation style and length), makes them more engaging to users?'. We can measure the different engagement responses from users who watch three different lengths of the one presentation style, and also measure other users who are exposed to two different video styles both of which have similar video lengths.

Estimated times for testing procedure

12 participants viewing 3 different video timings

- Pre-study background questionnaire (0 minutes)
- Introduction and explanation (5 minutes)
- Reading of study script and screener (3 minutes)
- Signing of consent form (2 minutes)
- Brief training on use of the learning app and choice of headphones (3 minutes)
- 1st video (3 minutes)
- Explanation of next step (1 minute)
- Post video engagement questionnaire (5 minutes)
- Post video test (5 minutes)
- 2nd video (5 minutes)
- Post video engagement questionnaire (5 minutes)
- Post video test (5 minutes)
- 3rd video (10 minutes)
- Post video engagement questionnaire (5 minutes)
- Post video test (5 minutes)
- Semi-Structured interview recorded on audio recorder to gather qualitative experience (5 mins)
- Closing of session and thanks for participation (5 minutes)

= Total 1 hour 12 minutes.

12 participants viewing 2 different presentation styles

- Pre-study background questionnaire (0 minutes)

- Introduction and explanation (5 minutes)
- Signing of consent form (2 minutes)
- Reading of study script (3 minutes)
- Brief training on use of the learning app and choice of headphones (3 minutes)
- 1st video (3 minutes)
- Explanation of next step (1 minute)
- Post video engagement questionnaire (5 minutes)
- Post video test (5 minutes)
- 2nd video (3 minutes)
- Post video engagement questionnaire (5 minutes)
- Post video test (5 minutes)
- 3rd video (5 minutes)
- Post video engagement questionnaire (5 minutes)
- Post video test (5 minutes)
- 4th video (5 minutes)
- Post video engagement questionnaire (5 minutes)
- Post video test (5 minutes)
- Semi-Structured interview recorded on audio recorder to gather qualitative experience (5 mins)
- Closing of session and thanks for participation (5 minutes)

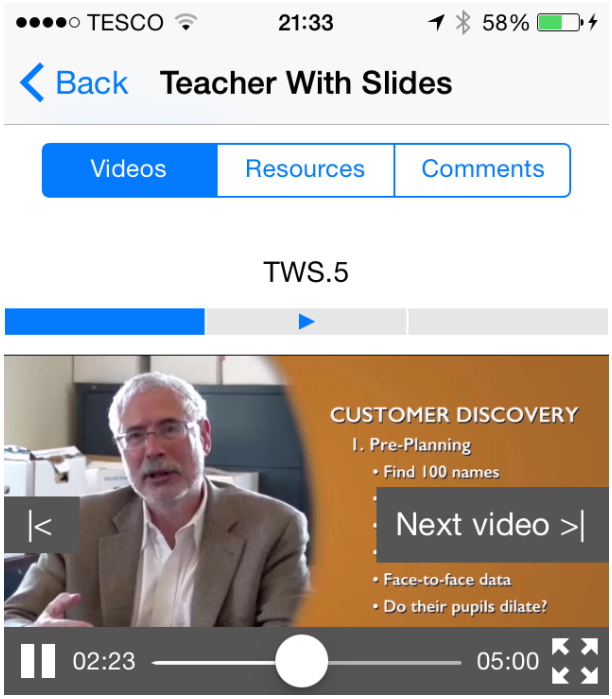
= Total 1 hour 34 minutes.

Timeline

Task	July 9-15	July 16-22	July 23-31	Aug 1-7	Aug 8-14	Aug 15-21	Aug 22-31	Sept 1-8	Sept 9-15	Sept 16-22	Sept 23-30
Build Study Plan											
Redo Dissertation Timeline											
Find Engagement & Learning Measurement Techniques											
Source Video Teaching Content											
Work on Literature Review											
Identify Participants for Study											
Develop Pre and Post Test Questionnaires, Examinations and Materials											
User Testing Sessions											
Analysis of Data											

Task	Oct 1-8	Oct 9-15	Oct 16-22	Oct 23-31	Nov 1-8	Nov 9-15	Nov 16-22	Nov 23-30	Dec 1-8	Dec 9-15	Dec 16-22	Dec 23-31
User Testing Sessions (Contd)												
Analysis of Data (Contd)												
Write up findings and conclusions												
Complete set of guidelines												
Submit draft to supervisor												
Revise draft and complete												
Submit final dissertation												

Appendix C – Video Lesson Screenshots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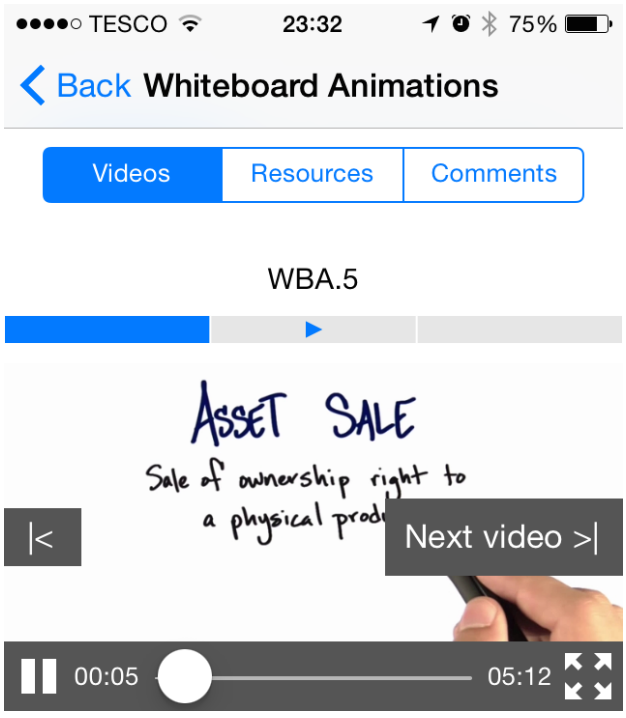
Back Teacher With Slides
Videos Resources Comments
CUSTOMER DISCOVERY
1. Pre-Planning
• Find 100 names
• Face-to-face data
• Do their pupils dilate?
Next video >|
02:23 05:00

TWS.5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Sale of ownership right to
a physical prod
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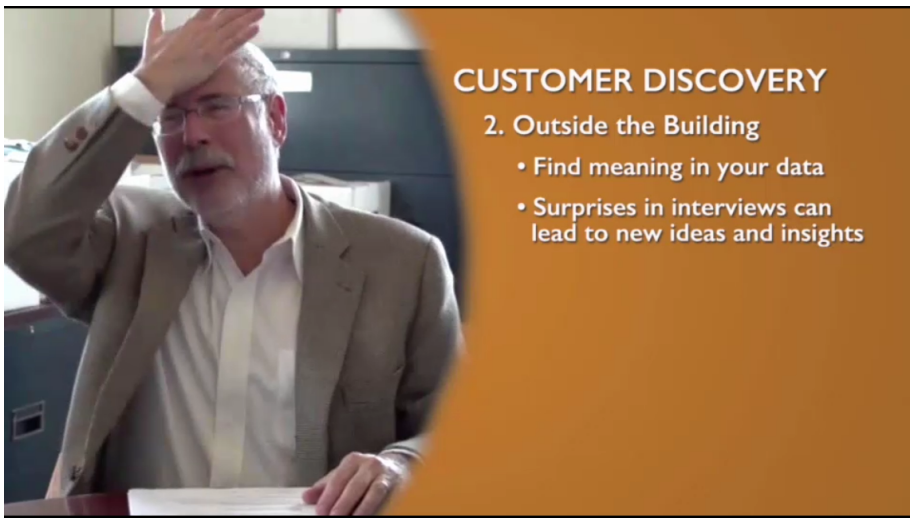
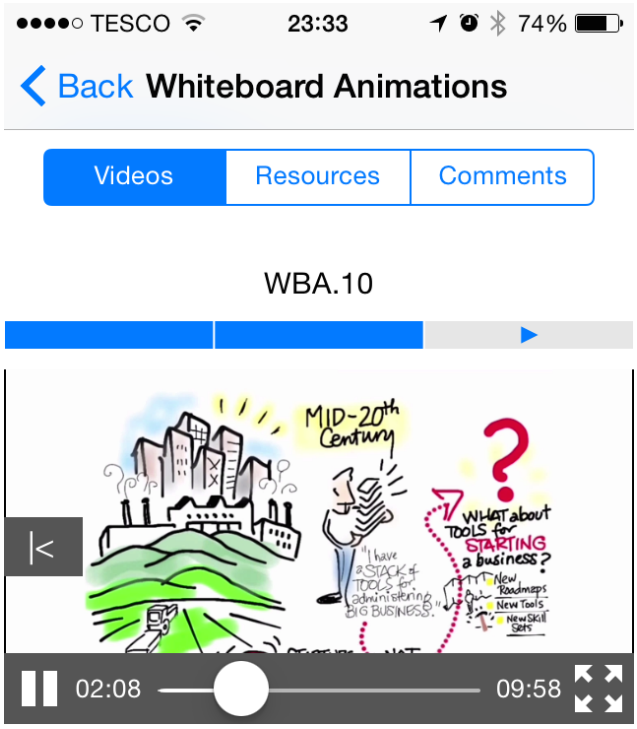
WBA.5


CUSTOMER DISCOVERY
2. Outside the Building
• Find meaning in your data
• Surprises in interviews can lead to new ideas and insights


TESCO
23:33
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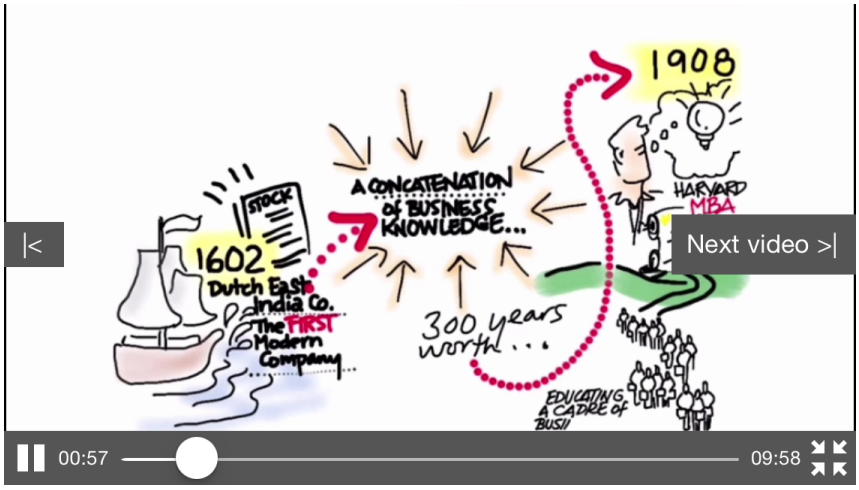
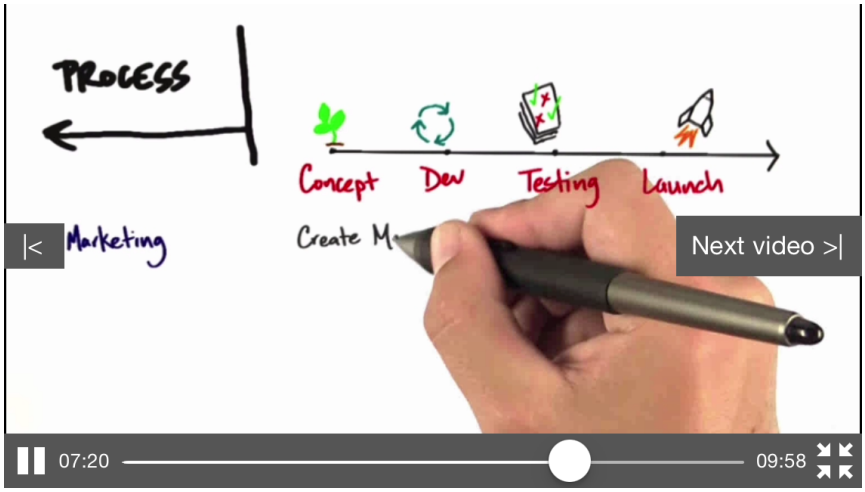
Back Whiteboard Animations
Videos
Resources
Comments
WBA.10
MID-20th Century
WHAT about TOOLS for STARTING a business?
02:08
09:58


CUSTOMER DISCOVERY
2. Outside the Building
• Find meaning in your data
• Surprises in interviews can lead to new ideas and insights
• Insight requires a lot of interviews
07:18
10:05


1908
HARVARD MBA
A CONCATENATION OF BUSINESS KNOWLEDGE...
STOCK
1602
Dutch East India Co.
The FIRST Modern Company
300 years worth...
Next video >|
00:57
09:58


CUSTOMER DISCOVERY
3. Analysis & Insight
Next video >|
01:34
03:09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Concept
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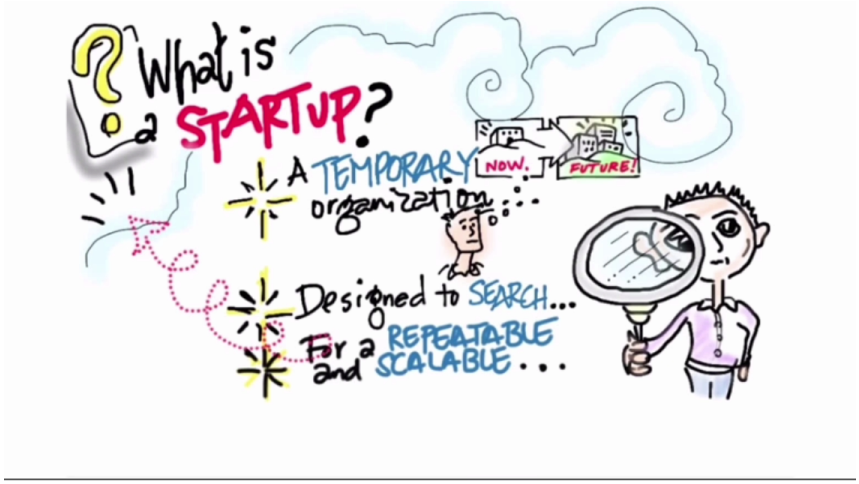
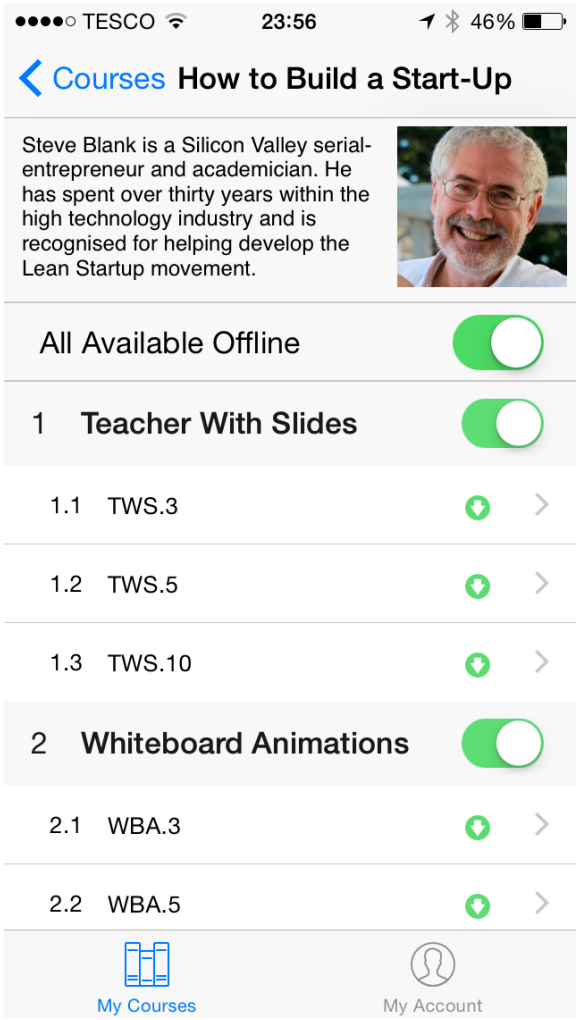


Appendix D – App Screenshot


TESCO
23:56
46%
Courses
How to Build a Start-Up
Steve Blank is a Silicon Valley serial-entrepreneur and academician. He has spent over thirty years within the high technology industry and is recognised for helping develop the Lean Startup movement.
All Available Offline
1 Teacher With Slides
1.1 TWS.3
1.2 TWS.5
1.3 TWS.10
2 Whiteboard Animations
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2.2 WBA.5
My Courses
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