Design of Electronic Services Employing Gamification: The impact of game elements on user behaviour and motivation

by

Stavros Lounis

Supervisors

Prof. George I.Doukidis, AUEB

Assoc. Prof. Aikaterini Pramatari, AUEB

Assoc. Prof. Aristeidis Theotokis, University of Leeds

A doctoral dissertation submitted in partial fulfillment of
the requirements for the Doctor of Philosophy degree in
Management Science and Technology
in the School of Business of
Athens University of Economics and Business

Athens
July 2017


ATHENS UNIVERSITY OF ECONOMICS & BUSINESS
ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

Σχεδίαση Ηλεκτρονικών Υπηρεσιών με χρήση Παιγνιοποίησης: Επίδραση των δομικών στοιχείων παιχνιδιών στη συμπεριφορά και παρακίνηση χρηστών

του

Σταύρου Λουνή

Επιβλέποντες:
Καθ. Γεώργιος Δουκίδης, Ο.Π.Α.
Αναπλ. Καθ. Κατερίνα Πραματάρη, Ο.Π.Α.
Αναπλ. Καθ. Αριστείδης Θεοτόκης, University of Leeds

Διδακτορική διατριβή υποβληθείσα ως μερική εκπλήρωση
των υποχρεώσεων για την απονομή του τίτλου του
Διδάκτορα της Διοικητικής Επιστήμης και Τεχνολογίας
της Σχολής Διοίκησης Επιχειρήσεων του
Οικονομικού Πανεπιστημίου Αθηνών

Αθήνα
Ιούλιος 2017


ATHENS UNIVERSITY OF ECONOMICS & BUSINESS
ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

Per aspera ad astra. Στους γονείς μου Κωνσταντίνο και Άννα και την αδερφή μου Κατερίνα που είναι πάντα εκεί στα δύσκολα.


ATHENS UNIVERSITY OF ECONOMICS & BUSINESS
ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

ACKNOWELDGMENTS

This doctoral thesis is the product of a research work that would not have been completed in its current form if it hadn't received the support and valuable input of the people that were directly and indirectly involved in the process. In this limited space, I will try to express my gratitude to all those that have been and continue to be by my side in my academic endeavors.

Initially, my warmest gratitude goes to my supervising committee, who embraced my curious mind and enabled me to think in a multitude of ways. I would like to thank Professor George I. Doukidis who has been my mentor and simultaneously the person I academically aspire to be. He founded the ELTRUN E-Business R.C. and provided Greece with a research center of the highest standards, member of which I have been fortunate to be. In our discussions over the years, I was enabled to develop a strategic mindset as I learnt how to identify the hidden values in phenomena around me and to literally see into the future way ahead of time. I would also like to thank from the bottom of my heart Associate Professor Katerina Pramatari, who understood me and supported me in numerous occasions the past years. Every discussion with her changed me bit by bit, enabling me to break down visions and goals into attainable bits of tasks and further on helped me tremendously on every bit along the way, psychologically and mentally, by understanding and guiding me. I would also like to thank Associate Professor Aristeidis Theotokis who is a person I highly lookup to. In a short time, he has achieved to complete research others never do in their lifetime and the best are yet to come. In our discussions I was able to explore my own research more thoroughly and with academic vigor.

This doctoral research was conducted in the ELTRUN E-Business Research Center of the Department of Management Science and Technology of the Athens University of Economics and Business. I would like to personally thank all the members of the research center, who have

come from being colleagues to being family. It is of utmost importance to be embraced and surrounded by people of such qualities and I have been fortunate enough to experience that. Last but certainly not least I would like to thank my family who have been there for me from the get go, still are and will always be.

Finally, I would like to express my gratitude to the partners of the e-SAVE Research Project for providing valuable input and support to the empirical research conducted as part of this doctoral Thesis

ΠΕΡΙΛΗΨΗ

Η παιγνιοποίηση ηλεκτρονικών υπηρεσιών άνθισε την τελευταία δεκαετία και επιχειρήσεις ανά τον κόσμο έσπευσαν να την εντάξουν στον στρατηγικό τους σχεδιασμό για την ικανότητα παροχής προηγμένων ηλεκτρονικών υπηρεσιών. Η παιγνιοποίηση (gamification) αποτελεί τον μετασχηματισμό μιας ηλεκτρονικής υπηρεσίας με την προσθήκη δομικών στοιχείων (game elements) και λειτουργιών παιχνιδιού (game dynamics), ως μέσο ενίσχυσης της ηλεκτρονικής υπηρεσίας και μετασχηματισμού της σε μια νέα υπηρεσία η οποία εξυπηρετεί τον αρχικό της στόχο προσθέτοντας ένα επίπεδο αλληλεπίδρασης που παραδοσιακά συναντάται στα ηλεκτρονικά παιχνίδια. Η ταχεία ανάπτυξη της παιγνιοποίησης οδήγησε στη δημιουργία μιας αγοράς η οποία προβλέπεται να αγγίξει τα $11 δις. Δολάρια μέχρι το 2020. Παραδείγματα παιγνιοποίησης ηλεκτρονικών υπηρεσιών συναντώνται στους τομείς (non-game contexts) της εκπαίδευσης, της υγείας, του ηλεκτρονικού εμπορίου και του μάρκετινγκ μεταξύ άλλων, με σειρά από στόχους όπως η εκπαίδευση των χρηστών στις διαδικασίες και τον συνολικό στόχο της ηλεκτρονικής υπηρεσίας, η αλληλεπίδραση με την ηλεκτρονική υπηρεσία και η υποστήριξη βραχυπρόθεσμης αλλαγής συμπεριφοράς. Τα πιθανά οφέλη από την εισαγωγή δομικών στοιχείων και διαδικασιών που παραδοσιακά συναντώνται σε ηλεκτρονικά παιχνίδια σε ηλεκτρονικές υπηρεσίες που δεν έχουν παιγνιώδη στοιχεία, αφορούν τους τελικούς χρήστες (παρακίνηση και διασκέδαση εκτέλεσης δραστηριοτήτων και διαδικασιών) ως επίσης και τις επιχειρήσεις (αυξημένη αλληλεπίδραση με την ηλεκτρονική υπηρεσία, πιστότητα). Τα οφέλη όμως μπορούν να τα καρπωθούν τόσο οι τελικοί χρήστες όσο και οι επιχειρήσεις εάν και μόνο εάν έχει πραγματοποιηθεί σωστός σχεδιασμός και εισαγωγή των δομικών μερών των παιχνιδιών στην ηλεκτρονική υπηρεσία. Η αστοχία στον σχεδιασμό οδήγησε την Gartner (2012) να

προβλέψει ότι “περίπου το 80% των παιγνιοποιημένων εφαρμογών [της περιόδου] θα αποτύχει να ικανοποιήσει τους στόχους της εταιρίας εξαιτίας κακού σχεδιασμού”.

Η υπάρχουσα όμως βιβλιογραφία σχετικά με την παιγνιοποίηση ηλεκτρονικών υπηρεσιών παρουσιάζει ερευνητικά κενά. Η παιγνιοποίηση εξετάζεται από τα πεδία των πληροφοριακών συστημάτων, του μάρκετινγκ και των ψηφιακών μέσων για τα οφέλη της και ερευνητές μελετούν την αποτελεσματικότητά της και τη διαδικασία μετασχηματισμού των ηλεκτρονικών υπηρεσιών. Καταρχήν, οι ερευνητικές προσπάθειες εστιάζουν στην εξέταση παιγνιοποιημένων συστημάτων τα οποία χρησιμοποιούν ριζικά διαφορετικά τα δομικά στοιχεία στον βαθμό που τα αποτελέσματα δεν μπορούν να συγκριθούν μεταξύ τους (Seaborn and Fels, 2015) οδηγώντας στην ανικανότητα κατανόησης του ρόλου των δομικών στοιχείων και του σχεδίου στο επιθυμητό αποτέλεσμα. Επιπροσθέτως, μια σειρά από θεωρητικά πλαίσια παιγνιοποίησης (gamification frameworks) έχουν προταθεί από ειδικούς του χώρου και την ακαδημία, όπως το 6D, το Octalysis και το “Framework for success”, τα οποία αν και χρησιμοποιούνται για τον σχεδιασμό παιγνιοποιημένων ηλεκτρονικών υπηρεσιών δεν έχουν επικυρωθεί. Η ακαδημαϊκή βιβλιογραφία αναγνωρίζει τις ιδιότητες των βασικών δομικών μερών τα οποία μπορούν να χρησιμοποιηθούν στον σχεδιασμό μιας ηλεκτρονικής υπηρεσίας με παιγνιώδεις ιδιότητες παρουσιάζοντας τους πόντους (points), τα εμβλήματα (badges), τους πίνακες κατάταξης (leaderboards), τα ανταποδοτικά κίνητρα (rewards) και τα επίπεδα δυσκολίας (levels) ως βασικά δομικά στοιχεία τα οποία μπορούν να συσχετιστούν με διαδικασίες αλληλεπίδρασης και κανόνες ώστε να υποστηρίξουν τους στόχους της υπηρεσίας, όπως αυτοί πραγματοποιούνται μέσα από τις διαδικασίες που καλούνται να πραγματοποιήσουν οι τελικοί χρήστες. Τα βασικά αυτά δομικά στοιχεία επεκτείνονται από δευτερεύοντα όπως οι αναπαραστάσεις χρηστών (avatars), οι αποστολές (missions) και τα επίπεδα αναγνώρισης

(status) μεταξύ άλλων. Με βάση έναρξης τα δομικά στοιχεία και την προσθήκη κανόνων αλληλεπίδρασης προκύπτει το σχέδιο της παιγνιοποίησης (gamification design) της ηλεκτρονικής υπηρεσίας προς μελέτη και υλοποίηση. Το αποτέλεσμα όμως της μελέτης συνολικών συστημάτων όπως επίσης και η ανικανότητα κατανόησης της επιμέρους επίδρασης του εκάστοτε δομικού στοιχείου στον συνολικό σκοπό της παιγνιοποίησης οδηγεί στην ανάγκη μελέτης μεμονωμένων δομικών στοιχείων όπως επίσης και συνδυασμού αυτών για της επίδρασή τους, ανάγκη που αναγνωρίστηκε από την ακαδημαϊκή κοινότητα (Hamari et al.,2014; Seaborn and Fels, 2015; Deterding, 2017) με την ωρίμανση του χώρου. Επιπροσθέτως, καθώς η παιγνιοποίηση έχει στόχο την παρακίνηση των χρηστών, η ανάγκη για τη μελέτη του υποκείμενου μηχανισμού παρακίνησης είναι έκδηλη. Αρχικές έρευνες στον χώρο προσδιορίζουν τη θεωρία του αυτοπροσδιορισμού (Self Determination Theory) ως μια από τις βασικές θεωρίες υπό το πρίσμα της οποίας μπορεί να μελετηθεί το φαινόμενο της παιγνιοποίησης ως μέσο της ανάγκης των ανθρώπων να αναζητούν ενεργά προκλήσεις και νέες εμπειρίες. Εξετάζοντας τα εσωτερικά και εξωτερικά κίνητρα τα οποία εισάγει και υποστηρίζει η παιγνιοποίηση, μέσω των δομικών της μερών που υλοποιούνται, μπορεί να διερευνηθεί η συνεισφορά του εκάστοτε δομικού μέρους στο σύνολο της ηλεκτρονικής υπηρεσίας.

Η παρούσα διδακτορική έρευνα μελετά την επίδραση των δομικών μερών των ηλεκτρονικών παιχνιδιών στην εισαγωγή τους σε μια παιγνιοποιημένη ηλεκτρονική υπηρεσία με στόχο να αναγνωρίσει τη συνεισφορά τους μεμονωμένα και σε συνδυασμό στον τελικό στόχο της υπηρεσίας, που είναι η παρακίνηση αλληλεπίδρασης με τους τελικούς χρήστες, όπως επίσης και εξετάζει τους μηχανισμούς παρακίνησης που υποστηρίζουν τα δομικά στοιχεία υπό το πρίσμα της θεωρίας του αυτοπροσδιορισμού.

Για την επίτευξη του ερευνητικού αυτού στόχου πραγματοποιείται αρχικά η επισκόπηση της σχετικής βιβλιογραφίας και η τοπογράφηση των προηγουμένων σχετικών ερευνών για την αναγνώριση και σύνδεση των θεωριών και των σημαντικών ερευνητών του χώρου. Στο δεύτερο κεφάλαιο της διατριβής αναλύεται η περιοχή της παιγνιοποίησης ηλεκτρονικών υπηρεσιών και παρουσιάζονται οι μέχρι στιγμής έρευνες που υποστηρίζουν τον χώρο αναφορικά με τα οφέλη της εισαγωγής της. Ακολούθως παρουσιάζονται και αναλύονται τα αναγνωρισμένα δομικά μέρη ηλεκτρονικών παιχνιδιών τα οποία χρησιμοποιούνται στη διαδικασία του σχεδιασμού όπως επίσης και τα θεωρητικά πλαίσια σχεδιασμού ηλεκτρονικών υπηρεσιών. Τέλος παρουσιάζονται τα αποτελέσματα των βασικών ερευνών στον χώρο και στοιχειοθετείται η ανάγκη για την έρευνα της παρούσης διδακτορικής διατριβής. Στο πλαίσιο του δευτέρου κεφαλαίου παρουσιάζεται επίσης η προκαταρκτική έρευνα που παρακίνησε την ανάγκη για την τρέχουσα έρευνα και παρείχε σημαντικά δεδομένα για την έναρξη και εξέλιξη της ερευνητικής διαδικασίας. Η προκαταρτική έρευνα αποτελείται από δύο περιπτώσεις σχεδίασης παιγνιοποιημένων ηλεκτρονικών υπηρεσιών, η πρώτη αναφορικά με τον σχεδιασμό υπηρεσίας παρακίνησης για εξοικονόμηση ενέργειας στον εργασιακό χώρο και η δεύτερη αναφορικά με τον σχεδιασμό υπηρεσίας συνεργατικής παραγωγής βιβλίων και διαδραστικών εφαρμογών για παιδιά. Τα αποτελέσματα της βιβλιογραφικής επισκόπησης όπως επίσης και των δύο περιπτώσεων σχεδιασμού παιγνιοποιημένων ηλεκτρονικών υπηρεσιών οδηγούν στην αναγνώριση του κεντρικού ερευνητικού ερωτήματος που καθοδηγεί την παρούσα έρευνα ως ακολούθως:

Ποια είναι η μεμονωμένη και συνδυαστική επίδραση των δομικών στοιχείων παιχνιδιών στα συμπεριφορικά αποτελέσματα - στόχους μιας παιγνιοποιημένης ηλεκτρονικής υπηρεσίας;

Το ερώτημα αυτό επεκτείνεται επίσης στο να συμπεριλάβει την επίδραση στα ψυχολογικά αποτελέσματα όπως επίσης και στη διερεύνηση της διαδικασίας αλληλεπίδρασης των ψυχολογικών και συμπεριφορικών αποτελεσμάτων.

Το τρίτο κεφάλαιο αναλύει τη μεθοδολογία έρευνας που ακολουθήθηκε για να απαντηθούν τα ερευνητικά ερωτήματα. Στο συγκεκριμένο κεφάλαιο παρουσιάζονται οι ερευνητικές και επιστημολογικές προσεγγίσεις που έχουν ακολουθηθεί, όπως επίσης πραγματοποιείται η παρουσίαση του ερευνητικού σχεδιασμού και των μεθόδων συλλογής, επεξεργασίας και ανάλυσης των δεδομένων βάσει των οποίων πραγματοποιήθηκε ο έλεγχος των υποθέσεων της διδακτορικής διατριβής.

Το τέταρτο κεφάλαιο της παρούσας διδακτορικής διατριβής παρουσιάζει τις αρχικές μελέτες που έχουν ως στόχο την αναγνώριση των δομικών στοιχείων, όπως επίσης και των δυνητικών σχεδιασμών παιγνιοποίησης που μπορούν να χρησιμοποιηθούν στο πλαίσιο της παιγνιοποίησης της ηλεκτρονικής υπηρεσίας, με βάση τη μεθοδολογία της συμμετοχής καινοτόμων χρηστών στη διαδικασία σχεδιασμού και ανάπτυξης μιας ηλεκτρονικής υπηρεσίας. Η πρώτη διερευνητική ποιοτική έρευνα αποτελείται από μια σειρά από προσωπικές συνεντεύξεις με δεκαπέντε χρήστες που πληρούσαν τα κριτήρια ώστε να ανήκουν στην κατηγορία των «καινοτόμων χρηστών». Στο πλαίσιο των προσωπικών συνεντεύξεων διερευνήθηκαν οι αντιλήψεις των χρηστών αναφορικά με το πεδίο εφαρμογής της παιγνιοποίησης (non-game context), τα δομικά στοιχεία στη διάθεση των σχεδιαστών (game elements), όπως επίσης και τον τρόπο με τον οποίο θα μπορούσαν να συνδυαστούν και να αλληλεπιδρούν με τους χρήστες (dynamics). Το αποτέλεσμα των συνεντεύξεων ήταν η αναγνώριση δομικών στοιχείων τα οποία θα μπορούσαν χρησιμοποιηθούν στην ηλεκτρονική υπηρεσία, όπως επίσης και τα δομικά στοιχεία τα οποία παρουσίαζαν ερευνητικό ενδιαφέρον καθώς δεν υπήρχε κοινή αντίληψή για το

δυνητικό αποτέλεσμά τους. Ακολούθως των προσωπικών συνεντεύξεων και με στόχο την παραγωγή δυνητικών δυναμικών (dynamics) μεταξύ των δομικών στοιχείων (game elements) όπως επίσης και για τον προσδιορισμό του περιεχομένου της ηλεκτρονικής υπηρεσίας πραγματοποιήθηκαν συζητήσεις στο πλαίσιο ομάδων εμβάθυνσης (focus groups) με καινοτόμους χρήστες. Στις δύο ομάδες εμβάθυνσης που πραγματοποιήθηκαν με τη συμμετοχή δεκαέξι καινοτόμων χρηστών καταγράφηκαν οι δυνητικοί συνδυασμοί των δομικών στοιχείων και οι τρόποι αλληλεπίδρασής τους με τους τελικούς χρήστες προς μελέτη, όπως επίσης και το περιεχόμενο της παιγνιοποιημένης ηλεκτρονικής υπηρεσίας. Το αποτέλεσμα της αρχικής έρευνας ήταν η επιλογή τριών δομικών στοιχείων (Πίνακες κατάταξης, Ανταποδοτικά κίνητρα και Τύπος συμμετοχής (ατομικός ή συνεργατικός)) που θα μπορούσαν να μελετηθούν για την αποτελεσματικότητά τους στην τελική παιγνιοποιημένη ηλεκτρονική υπηρεσία.

Βασιζόμενοι στα αποτελέσματα της αρχικής έρευνας πραγματοποιήθηκε η πρώτη ποσοτική εμπειρική μελέτη (Κεφάλαιο 5) με στόχο τη διερεύνηση της επίδρασης που έχουν δύο από τα δομικά στοιχεία (Ανταποδοτικά κίνητρα – Rewards και Τύπος συμμετοχής – Mode of play) στον βαθμό εσωτερικής παρακίνησης των χρηστών όπως επίσης και διασκέδασης κατά τη συμμετοχή στην παιγνιοποιημένη ηλεκτρονική υπηρεσία. Οι ερευνητικές υποθέσεις αυτής της μελέτης προτείνουν πως [H_1] εσωτερικά προσανατολισμένα ανταποδοτικά κίνητρα (Intrinsic oriented rewards, π.χ. επιτυχία να βοηθήσεις το περιβάλλον) θα οδηγήσουν σε υψηλότερη αντίληψη διασκέδασης κατά τη διάρκεια συμμετοχής σε σχέση με εξωτερικά προσανατολισμένα ανταποδοτικά κίνητρα (Extrinsic oriented rewards, π.χ. λήψη έκπτωσης σε επόμενη αγορά). Επιπροσθέτως, υποθέσαμε πως [H_2] η συμμετοχή στην υπηρεσία και τους στόχους με τη μορφή συνεργασίας στο πλαίσιο ομάδας (Team collaboration) θα οδηγήσει σε υψηλότερη αντίληψη διασκέδασης κατά τη διάρκεια συμμετοχής σε σχέση με τη μεμονωμένη ατομική συμμετοχή

(Single play). Για να ελέγξουμε τις ερευνητικές υποθέσεις σχεδιάσαμε και υλοποιήσαμε την πρώτη έκδοση της παιγνιοποιημένης ηλεκτρονικής υπηρεσίας υπό τη μορφή διαδραστικών προσχεδίων (interactive mockups) σε τέσσερεις εκδόσεις. Κατόπιν παρουσιάσαμε μια από τις τέσσερεις εκδόσεις με τυχαίο τρόπο σε 118 χρήστες στο πλαίσιο εργαστηριακού πειράματος ακολουθώντας τον σχεδιασμό ανεξάρτητων δειγμάτων (between subjects design). Τα αποτελέσματα του πρώτου εργαστηριακού πειράματος παρέχουν αρχική υποστήριξη για την H_2, δηλαδή τον ισχυρισμό ότι σε μια παιγνιοποιημένη ηλεκτρονική υπηρεσία η παροχή δυνατότητας συμμετοχής υπό τη μορφή της ομάδας και πιο συγκεκριμένα της συνεργασίας μπορεί να οδηγήσει σε αυξημένη αντίληψη διασκέδασης κατά τη διάρκεια συμμετοχής. Αντιθέτως η H_1 δεν έλαβε αρχική υποστήριξη καθώς η παροχή εσωτερικά προσανατολισμένων και εξωτερικά προσανατολισμένων ανταποδοτικών κινήτρων (Intrinsic vs. Extrinsic oriented rewards) δεν παρουσίασε διαφορετικά αποτελέσματα στην αντίληψη διασκέδασης των χρηστών.

Το Κεφάλαιο 6 αποτελεί τη δεύτερη ποσοτική εμπειρική έρευνα η οποία πραγματοποιήθηκε με την ανεπτυγμένη παιγνιοποιημένη ηλεκτρονική υπηρεσία μέσω ενός πειράματος πεδίου (field experiment) και ακολουθώντας σχεδιασμό ανεξάρτητων δειγμάτων (between subjects design). Με τη χρήση της εφαρμογής έξυπνου κινητού τηλεφώνου που αναπτύχθηκε (POOLL) και το σύστημα υποστήριξης (backend) επετεύχθη η εκτέλεση πειράματος πεδίου που στόχο είχε τη διερεύνηση της επίδρασης των συνδυασμών δομικών μερών ηλεκτρονικών παιχνιδιών στη συμπεριφορά των τελικών χρηστών, όπως επίσης και στις αντιλήψεις των χρηστών. Συγκεκριμένα, μελετήθηκε ο συνδυασμός των Πινάκων κατάταξης (Ύπαρξη ανταγωνισμού έναντι Μεμονωμένης ατομικής συμμετοχής) και του Βαθμού δυσκολίας (Προοδευτικά αυξανόμενος vs Προοδευτικά Μειούμενος) για την επίδρασή τους στην αλληλεπίδραση των χρηστών με την ηλεκτρονική υπηρεσία, όπως επίσης και για την επίδρασή

τους στην υποστήριξη δημιουργίας αισθήματος επάρκειας σύμφωνα με τη θεωρία του αυτοπροσδιορισμού (Self Determination Theory). Οι ερευνητικές υποθέσεις αυτής της μελέτης προτείνουν πως σε μια παιγνιοποιημένη ηλεκτρονική υπηρεσία η παρουσία (έλλειψη) ανταγωνισμού με χρήση πινάκων κατάταξης σε πλαίσιο προοδευτικής αύξησης (μείωσης) δυσκολίας θα οδηγήσει σε [H_3] υψηλότερο αίσθημα επάρκειας στην παιγνιοποιημένη δραστηριότητα, [H_4] αυξημένη αλληλεπίδραση με την ηλεκτρονική υπηρεσία και [H_5] αυξημένη απόδοση στις δραστηριότητες, για τους τελικούς χρήστες. Επιπροσθέτως προτείνεται [H_6] ότι η αντίληψη επάρκειας κατά την αλληλεπίδραση με την υπηρεσία μεσολαβεί στα συμπεριφορικά αποτελέσματα της παιγνιοποίησης ως προς τον βαθμό αλληλεπίδρασης και την απόδοση.

Στο πείραμα πεδίου συμμετείχαν 153 χρήστες οι οποίοι/ες σε πραγματικές συνθήκες χρησιμοποίησαν την εφαρμογή κατά το δοκούν. Προ χρήσης και μετά τη χρήση της υπηρεσίας οι χρήστες συμπλήρωσαν ερωτηματολόγια τα οποία κατέγραψαν πλήθος μεταβλητών, όπως η αντίληψη επάρκειας, η αντίληψη αυτοδιάθεσης, η αντίληψης εσωτερικής παρακίνησης και διασκέδασης και δημογραφικά στοιχεία, σε επέκταση των καταγεγραμμένων από την υπηρεσία αλληλεπιδράσεων και επίδοσης στους στόχους της παιγνιοποιημένης ηλεκτρονικής υπηρεσίας. Τα αποτελέσματα αυτής της μελέτης επιβεβαίωσαν τις υποθέσεις και έδειξαν πως η χρήση και ο συνδυασμός δομικών μερών ηλεκτρονικών παιχνιδιών με στόχο τον μετασχηματισμό ηλεκτρονικών υπηρεσιών μπορεί να οδηγήσει σε διαφορετικά αποτελέσματα βάσει του σχεδιασμού παιγνιοποίησης.

Το έβδομο κεφάλαιο αποτελεί το καταληκτικό κεφάλαιο της διδακτορικής διατριβής. Στο συγκεκριμένο κεφάλαιο πραγματοποιείται μια σύνοψη της διατριβής, περιγράφονται οι έρευνες και τα αποτελέσματα, όπως επίσης και αναπτύσσονται οι κύριες συνεισφορές στη θεωρία και την πρακτική στον χώρο της παιγνιοποίησης ηλεκτρονικών υπηρεσιών. Το κεφάλαιο κλείνει με

την παρουσίαση των περιορισμών της έρευνας όπως επίσης και τις οδούς για μελλοντική έρευνα σε σχέση με την παιγνιοποίηση ηλεκτρονικών υπηρεσιών σε επίπεδα δομικών στοιχείων, πεδίων εφαρμογής και δυνητικών αποτελεσμάτων.

ABSTRACT

Gamification of electronic services has received over the past decade increased attention by both the industry and academia and various industries have introduced it in their offering as a medium to enhance their core offering with playful affordances. In the gamification phenomenon, different game elements, such as points, badges, leaderboards and other elements traditionally found in electronic games are infused in electronic services, that were not games themselves, as means to enable a playful interaction with the end-users. Examples of gamified electronic services can be found in education, health, employee productivity and sustainability, among others, with various goals pertaining to motivating users to engage with the service, adopt new behaviours and learn whilst playing.

Previous research on gamification, stemming mainly from digital media, marketing and IS, aims to demystify the phenomenon and understand the effect of introducing game elements in different non-game contexts. However, most researchers examine fully fledged gamification designs leading to incomparable results and insights that remain confined in the non-game context or even to the examined gamified service. As the gamification research matures, the need for isolated and combined examination of different game elements has been identified by several researchers in the field, as well as the need to examine the effect of different game elements on the goals of gamification. Furthermore, as gamification is evangelized as a medium that motivates people to conduct activities and tasks in a playful manner, research is sought after the underlying psychological mechanisms that are involved in the process. This doctoral research is focused on examining the isolated and combined effect of game elements on psychological and behavioural outcomes.

The doctoral thesis is based on two initial exploratory qualitative studies and two explanatory quantitative studies. Following the review and examination of the current state of gamification in the pertinent literature and motivated by the results of two different cases of gamification of electronic services, the design of a gamified electronic service in the non-game context of environmental awareness and consumption is utilized to identify the potential of game elements to affect the outcomes of gamification. Firstly, the initial exploratory qualitative studies aimed to identify the game elements that presented potential to be introduced in the gamified services as well as the game elements that presented ambiguous results and needed further research in the process of designing the gamified service. The outcome of the initial studies, consisting of a set of interviews and two focus groups, was that game elements were identified alongside with the potential content of the gamified service to be further examined. The first empirical experimental study is based on a laboratory experiment where 118 end-users experienced interactive mockups of the to-be gamified service, holding a set of identified game elements and the goal was to examine the effect of the game elements in the perceptions of enjoyment and intrinsic motivation to engage with the gamified service. Motivated by the results of this study, the second empirical experimental study, following the development of the gamified electronic service, utilized the smartphone application named POOLL in a field experiment to examine the effect of game elements in a real setting. With the participation of 153 end-users the field experiment had the purpose to investigate the direct effect of game elements on behavioural and psychological outcomes during participation, by taking into account the mediating effect of Perceived Competence as found in the Self Determination Theory.

Based on the multidisciplinary nature of gamification, results of this doctoral research contribute to the literature and practice in several ways. Initially, it explores the individual effects

of game elements and presents that besides the individual effects, combined game elements effect differently the psychological and behavioural outcomes of the gamified electronic service. Secondly it proposes the examination of gamification under the lens of Self Determination Theory, a prominent motivation theory for gamification. Furthermore, through the introduction of lead users in the design process, it proposes a new method for designing a gamified electronic service targeted to end-users. Fourthly, the results of this doctoral thesis enable managers to have an informed decision both on a set of game elements as well as on the process to examine additional game elements for introduction in their gamified electronic service. Lastly, as the gamified electronic service developed is designed to support gamification experimentation, irrelevant to the non-game context selected, this can be utilized by academics and managers as a tool for the experimentation towards the development of their respective gamified electronic services.

PUBLICATIONS

Working Journal Papers

1. “The effect of game elements on user activity: Evidence from the field” (with Pramatari K., Theotokis A., Gavalas L. and Doukidis G.), submitted to the *International Journal of Human-Computer Studies*.
2. “Gamification of electronic services: The mediating role of leaderboards and difficulty in perceived competence during participation” (with Pramatari K., Theotokis A. and Doukidis G.) to be submitted to the Special Issue: Theoretical Perspectives and Applications of Gamification in Business Context of the *Journal of Business Research*.
3. “Does one size fit all? Informing the design of a gamified system through experimentation” (with Pramatari K., Theotokis A. and Doukidis G.), to be submitted to the Special Issue of Immersive Systems of the *Journal of Management Information Systems*

Conference Papers

1. “Effecting Employee Energy Conservation Behaviour at the Workplace by utilising Gamification” (2017). In proceedings of *the Twenty-Fifth European Conference on Information Systems (ECIS)* (with Kotsopoulos D., Bardaki C. and Pramatari K.)
2. "Waste no more: Gamification for energy efficient behaviour at the workplace"(2017) *In proceedings of the GamiFin Conference*, Pori Finland (with Kotsopoulos D., Bardaki C., Papaioannou T. and Pramatari K.)
3. "Gamification of Authoring Interactive E-Books for Children: The Q-Tales Ecosystem" (2016). *In Proceedings of MCIS 2016*, Paper 2 (with Doukidis S., Papastamatiou N. and Doukoulos, T.)
4. “Gamification is all about fun: The role of Incentive Type and Community Collaboration.” (2014) *In proceedings of the 22nd European Conference on Information Systems – ECIS 2014*, Tel Aviv, Israel, June 9-11, 2014 (with Pramatari K., Theotokis, A.)
5. “Can Gamification Increase Consumer Engagement? A Qualitative Approach on a Green Case.” (2013*). In proceedings of the 12th IFIP WG 6.11* Conference on e-Business, e-Services, and e-Society, I3E 2013, Athens, Greece, April 25-26, 2013. (with Neratzouli X. and Pramatari K.)

Working Book

1. “Gamification of electronic services: From conception to successful implementation.”


ATHENS UNIVERSITY OF ECONOMICS & BUSINESS
ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

INDEX

LIST OF FIGURES

LIST OF TABLES

Chapter 1: Introduction

1.1 Motivation to Pursue Gamification

Gamification as the "*the use of game design elements in non-game contexts*" (Deterding et al. 2011) since its appearance in the past decade, received the attention of the industry as a prominent mean to transform electronic services in different non-game contexts, into gamified electronic services. This transformation is conducted by introducing a playful layer of interaction. Since its introduction in the Gartner hype cycle and Gartner's projection, that predicted the widespread application of enterprise gamification, where over 70% percent of Global 2000 organizations will employ at least one gamified application by 2014 (Gartner, 2011), an explosion of gamified technology-based services occurred. Startups and enterprises that offer gamification software as service packages, as well as large organization (e.g. SAP) explore gamification as means to engage consumers in their solutions has sprung. The offered applications and solution are found in various non-game contexts pertaining to education, marketing, education, employee productivity and health amongst others (Seaborn & Fels, 2015). Although gamification is nowadays an established practice and a standalone industry segment, Gartner (2012) identified that "about 80 percent of current gamified applications will fail to meet business objectives primarily due to poor design", in an industry sector that is projected to grow over $11 billion by 2020 (Markets and Markets, 2016).

The gamification phenomenon also received the attention of the academy in the past years and has been transformed from an interesting and novel research topic to a multi-disciplinary field of research, that initially started from attempting to explore and define gamification, to propose gamification frameworks, to subsequently examine ad-hoc and

standalone gamified systems in different non-game contexts and lately to identify the effect of gamification on users' behaviour (Hamari, Koivisto, & Sarsa, 2014; Seaborn & Fels, 2015). Gamification undergoes examination in different academic disciplines and efforts towards a definition of Gamification have been made respectively. From the service marketing perspective, focusing on the overall goals, Huotari & Hamari (2012, p.19) define gamification as "A process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation". From the educational perspective Lee and Hammer (2011, p.1) define Gamification as the "use of game mechanics, dynamics and frameworks to promote desired behaviours". To date the most adopted definition derives from Deterding et al. (2011) who define Gamification as ".. the use of design elements in a non-game context". The gamification paradigm has been applied into different non-game context such as Health (Hamari and Koivisto,2013; Hori et al.,2013), Education (Cheong et al.,2013; Denny,2013; Dong et al.,2012; Fitz-Walter et al.,2011; Li et al., 2012), Commerce and Marketing (Hamari and Jarvinen,2011; Hamari,2013) with different goals such as to engage participants (Burke, 2011), to motivate behavioural and psychological outcomes (Deterding et al., 2011; Huotari and Hamari, 2012) and to promote social interactions (Hamari, 2013; Hamari and Koivisto, 2013) amongst others. In order to enable the gamification of a non-game context the different game elements such as points, badges, leaderboards, rewards, levels, quests and challenges (De Paoli et al. 2012; Dominguez et al. 2013; Zichermann 2011) are combined under a gamification design, introduced in the gamified service and served mainly via technology based mediums such as PCs and mobiles over the internet. As such, gamification can be viewed as a method that enhances traditional electronic services currently extant in different non-game contexts via introducing playful affordances.

The appearance and the rapid development of gamified electronic services in various sectors in the industry is the primary motivation for this doctoral research. Further on the fact that although little research is currently extant on the effect that different game elements have on the overall gamification design of the gamified electronic services' goals, electronic services promising engagement and behaviour change through motivation in a playful manner appear in increasing rates in a to-be market of $11 billion. The aforementioned, leads us to study individual and combined game elements' effect on end users motivation and behavior when participating in a gamified electronic service.

1.2 The Gamification Research Context

The research context of this doctoral research is positioned in the gamification of electronic services. In today's service based economy, the infusion of modern technology has revolutionized the way services are provisioned, transforming traditional services into electronic services (or e-services). Electronic services are "electronic offerings for rent" that are made available and accessed over the Net in order to complete tasks, solve problems or conduct transactions (Doukidis et al., 2008; Hoffman, 2003). E-services are targeted to consumers and businesses and offered via different appliances (Vetter, 2001). Electronic services are defined (Hoffman, 2003) in two ways: (a) as online functionalities provided for rent to consumers in order to help them solve their problems and meet their needs and (b) as the "machine to machine provision of software functionality, potentially provided outside of human interaction or perception". In the first view of electronic services, followed in this doctoral research, in particular the use of gamification in extant electronic services aimed at helping people solve problems and meet needs can support the transformation of the electronic service into a gamified electronic service with engaging gameful affordances. Gamification advocates that the

introduction of a gameful layer upon the functionalities offered to the consumers will enable and foster interaction and engagement in a similar manner that is typically found in traditional electronic games. The consumer problems and needs in the case of gamification are reflected in the business or consumer goals of gamification, pertinent to each non-game context application. In a multitude of potential fields of application for gamified electronic services, the introduced game elements and resulting gamified electronic services are expected to drive behaviour and enhance engagement. However, each implementation requires that electronic services' designers take a plethora of gamification design decisions as well as account for the non-game context's specific attributes towards successfully implementing game-like experiences in the electronic service (Deterding, 2017; Seaborn and Fels, 2015). It is thus crucial to understand and evaluate the role each gamification design and game element plays during the design phase of a gamified electronic service (Deterding, 2017), building on prior research efforts in respect to the design of technology-based services (Davis et al. 1989; Theotokis et al. 2008; Venkatesh et al. 2003). Although implementations of gamification in practice present promising results, there is limited research that addresses the impact of different game elements and techniques on the overall user participation experience, engagement subsequent behaviour let alone the underlying motivational factors that enable it (Deterding, 2017; Seaborn and Fels, 2015). These sought after outcomes have often been used in order to guide design decisions and support the evaluation of electronic services (Bobbitt and Dabholkar 2001; Simon and Usunier 2007; Venkatesh et al. 2003), but have not been related to the use of gamification designs and game elements in electronic service design.

1.3 Research Gaps and Questions

Several researchers in the fields of digital media, marketing and information systems have spotted the potential benefits of the application of gamification in electronic services (Deterding, 2017; Hamari, Koivisto and Sarsa, 2014; Seaborn and Fels, 2015). Furthermore gamification practitioners and technology providers seek to understand the benefits and the process of introduction of gamification in their electronic services as means of transforming them into advanced service offerings (Guang Shi et al., 2017). However current efforts on identifying the potential benefits of gamification remain confined to examining gamified services at a pre- / post- gamification setting, built on top of vastly different gamification designs and different non-game contexts leading to incomparable results (Deterding, 2017; Seaborn and Fels, 2015). Furthermore most gamification designs are based upon newly proposed gamification frameworks such as Di Tomasso's "Framework for Success" (2011), Werbach and Hunter's "6D" (2012) and Octalysis (Chou, 2013) however little work is presently extant in the literature in terms of their validation (Deterding, 2017) leading to the need for the examination of design approaches to gamification of electronic services (Seaborn and Fels, 2015). Examples of the aforementioned issues have risen in the literature in the various extant efforts to map the gamification landscape. Hamari et al. (2014) in their examination of the up to date empirical studies on gamification identified that across the different research efforts the gamification employed in different electronic services transformation to gamified services, as well as the outcomes examined varied between the studies to the degree that formal meta-analysis could not be conducted. A similar issue was raised by Seaborn and Fels (2015) examination of 31 empirical papers on gamification in different domains. As previous work has focused mainly of overall gamified electronic services and not on the effect of initially isolated game elements and

subsequently combined game elements a clear research gaps is identified pertaining to the effect of the design decision for inclusion (and combination) of different game elements in the gamification of an electronic service. The aforementioned is further supported by the outcomes of an initial exploratory research that pertained to the design of two cases of gamified electronic services one relative to a service on energy efficiency in the workplace and a second on a service for the collaborative authoring of interactive applications and e-books for children. The results indicated the need for individual exploration of game element's effect on the aimed outcomes prior to the design of the final gamified electronic service. The outcomes of the cases in parallel with extant literature on gamification leads us to the initial research question of this thesis which is the following:

RQ1: *What is the individual and combined effect of game elements in the behavioural outcome goals of a gamified electronic service ?*

Extending the previous research gap and focusing on the goals of gamification as identified in the process of "Gamification design – Motivational outcomes – Behavioral outcomes" (Hamari et al., 2014; Huotari and Hamari, 2016), the gamification of electronic services is conducted with a set of goals in mind, driven by the non-game context's business goals. Main identified goals of gamification is to enhance engagement and performance through motivating participants to engage with the new gamified service (Deterding et al.,2011; Kosmadoudi et al., 2013; Simoes, Díaz Redondo, & Fernandez Vilas, 2013; Kuo and Chuang, 2016). Previous efforts aimed at identifying the behavioral and motivational outcomes of gamification primarily focused on the examination of ad-hoc gamified services have resulted in positive or mixed results. Indicatively, Dominigues et al. (2013) utilized a gamified design employing levels, challenges, badges and leaderboards in the education field in order to increase

students' motivation and engagement in learning experiences and the results of the application although revealed an increase in initial motivation subsequently led to poor written performance and participation in class. Cramer et al. (2011), utilized points, badges and status, in a gamified service aimed to encourage location sharing utilizing Foursquare. The results indicated that although the game elements could engage the participants with the gamified task, at cases they were demotivating. McDaniel et al. (2012) utilized a gamified design employing badges and leaderboards on online communities as means to enhance interactions. However the results were mixed and performance was modestly affected by the gamification design. Masson et al. (2013) utilized the game mechanics of points, badges and leaderboards with mixed results as the gamification design was found to increase the performance of the participants however not significantly.

Only in the latter years, the gamification researchers have turned their focus on individual game elements with notable examples Denny's (2013) examination of badges, Snyder and Hartig (2013) and Musthag et al. (2011) examination of rewards and Hori et al. (2013) examination of levels. Denny (2013) examined badges as means to motivate participation in online multiple choice question based learning system with results indicating that badges had an effect on the engagement with the learning system. Another example of badges examination in isolation comes from Passos et al (2011) utilizing medals (badges) in a study of a gamified software development method which presented mixed results with parts of the sample individuals and teams becoming more engaged than others. Snyder and Hartig (2013) examined the effect of the game element of rewards on an online quiz system for medical residents and results showed an 80% participation in the system as well as a 70% correct response rate leading the researchers to speculate that the gamification design employing rewards contributed to the engagement with the

system. Musthag et al. (2011) utilized the game element of rewards to motivate individuals to engage in submitting quality data in research studies with positive results in performance in the gamified task. Lastly in an effort to utilize gamification to encourage participants to smile more Hori et al. (2013), utilized the game element of levels yielding positive results where participants in the study showcased an increasing number of smiles. Although research on individual game elements yields positive results in cases, gamification design usually does not rely on a single game element but employees more in combination. It is evident, that further research is required to identify the benefits of gamification in the different non-game context and further more the role that each game-element plays in the overall goal of the respective gamification design.

However although the individual game elements examination has begun in terms of behavioural outcomes, there is a sizable gap in our knowledge of the effect of the gamification design to the psychological as little to non research has focused on how individual game elements when combined, effect differently the gamification design than when isolated. This leads to the following research questions of this doctoral research:

RQ2: *What is the individual and combined effect of game elements in the psychological outcome goals of a gamified electronic service ?*

As gamification aims to enable motivational outcomes of participants when interacting with a gamified electronic service, a number of motivation theories stemming from the field of psychology have been proposed as a theoretical lens under which gamification can be examined (Aparicio et al. 2012; Nicholson, 2012; Blohm and Leimeister, 2013; Sakamoto et al., 2012) such as Self Determination Theory, Situated Motivational Affordance, Activity Theory, Goal Setting Theory, Flow Theory and Fogg's Behavior Model with the most prominent being Self-Determination Theory (Deterding, 2015; Seaborn and Fels, 2015). Although Self Determination

Theory has been identified as a prominent theory under which gamification can be examined, little research is presently extant with the focus of identifying the potential of gamification to motivate participants on gamified tasks (Mekler et al. 2015; Deterding, 2017). The previous identified gap of individual game element examination in parallel with combined game element examination on motivational and behavioural outcomes, when viewed under the most prominent motivation theory in gamification (i.e. Self Determination Theory), leads to the need for examination on how the game elements available in the gamification domain can enable the satisfaction of the core needs found in Self Determination Theory. In particular when examining gamification under which conditions and how the game elements can be utilized to support the need for Competence, Autonomy and Relatedness when interacting with a gamified electronic service as means to enable their Intrinsic Motivation to participate in the gamified electronic service. The aforementioned gap leads to the following research questions in this doctoral research:

RQ3: *What is the effect of game elements and gamification design on Perceived Competence, Autonomy, Relatedness of participants?*

RQ4: *What is the relation of the game elements to the interplay of the psychological and behavioural outcomes?*

The above four research questions are the basic objectives of this doctoral study and based on these questions we build this thesis.

1.4 Expected Contribution and Thesis outline

Following the approach of the gamification initiative, this doctoral thesis has the purpose to examine game elements under gamification designs applied in an electronic service of a non-game context and empirically test the designed gamified electronic service on its capacity to enable behavioral and motivational outcomes on the end participants. Previous research efforts have mainly focused on the examination of gamification designs and application on non-game contexts as an overall system, not being able to distinguish the effect each game element had on the outcomes of the study, therefore the present doctoral research aims to address that gap, and provide a knowledge contribution to the existing gamification research and practice. In particular the examined game elements are rewards, game play mode and difficulty in progressing in the gamified electronic service's tasks, game elements that were previously unexamined in parallel in isolation and in combination under the same non game context. Additionally and pertaining to the non-game context, the non-game context of environmental awareness and environmentally conscious consumption is examined for its eligibility to be gamified via an electronic service employing the aforementioned game elements.

Further to the examination of individual and in parallel combined game elements and based on the Self Determination Theory, the game elements in isolation and gamification design as a combination of game elements is examined for their capacity to support the innate feelings for the satisfaction of the basic needs of Competence, Autonomy and Relatedness leading to perceptions of intrinsic motivation to participate in a gamified electronic service. Based on the above expectations of this doctoral thesis we can formulate the overall thesis purpose as:

To examine game elements' effects in isolation and in combination in a gamified electronic service of a non-game context with the goal to identify their capacity to enhance the psychological and behavioural outcomes as well as identify the underlying motivational affordances put forth by the gamification design.

In order to achieve the purpose of the doctoral thesis, a literature review on the relevant disciplinces is conducted, followed by the presentation of the two gamification cases and the respective research questions are built and provided in Chapter 2. Chapter 3 follows by presenting the epistemological and methodological considerations of the thesis and the overall research strategy followed. In Chapter 4 the exploratory phase is presented were a set of interviews and focus groups was utilized to identify the most prominent game elements and gamification designs for the gamification of the electronic service at hand. Building on the findings of the initial exploratory phase of this doctoral thesis, Chapter 5 present the first empirical study where the game elements of rewards and game play are examined in a laboratory setting as means to identify for their effect on the intrinsic motivation and enjoyment of participants in the first version of the gamified electronic service. Chapter 6 presents the second empirical study of this doctoral thesis where building on the findings of the previous work, two game elements are examined for their effect on behavioural and psychological outcomes put forth by the Self Determination Theory. This study was conducted in a field experiment where the developed gamified electronic service was utilized. Lastly in Chapter 7 this thesis is concluded by providing the theoretical and managerial implications of this research as well as the suggestions for future research. The structure of the doctoral thesis is shown schematically in Figure 1.

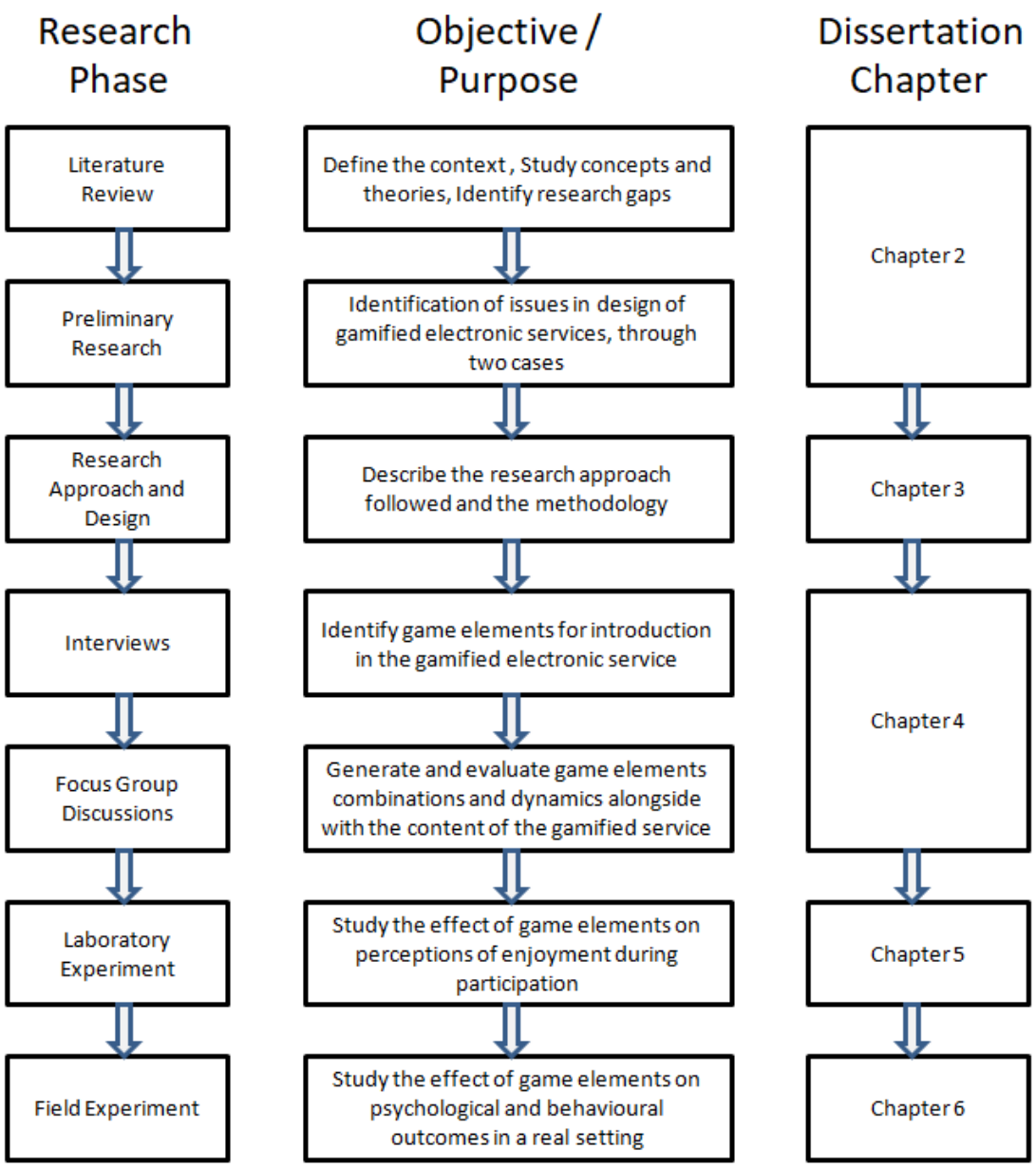


Figure 1: Thesis Outline

Chapter 2: Literature review and Preliminary research

The literature review chapter of this doctoral thesis has a set of four purposes. Initially, to survey the current state of literature in the gamification field, secondly to identify the key authors, articles, theories, and findings pertinent to the topic investigated thirdly to present the key findings from the preliminary research conducted in gamification of electronic services in two different cases and to identify the research gaps in knowledge, all with respect to gamification of electronic services. Therefore, the objective of this chapter is to provide an overview of the relevant to the thesis literature on gamification research in an organized and critical way as well as to present identified issues stemming from the gamification practice.

2.1 Gamification in the Academic Literature

2.1.1 Gamification of Electronic Services

In order to identify the potential benefits and pitfalls of gamification of electronic services, one must navigate first the landscape of services. Although a number of definitions are extant (see Mathe and Shapiro, 1993; Kotler, 1994; Gronroos,1998) a broad definition of the service concept comes from the services management and marketing field where Zeithaml et al. (2008) conceptualizes a service as “Deeds, process or performances provided or coproduced by one entity or person for another entity or person” (Zeithaml et al.,2008). A service as it is a broad concept can be further segmented in different categories utilizing the different levels the service entails namely, service industries and companies, services as products, customer service, and derived service (for a detailed description see Theotokis, 2009). The technological process and the rapid infusion of technology in everyday lives led to the emergence of Electronic Services. Electronic services (or e-services) have been defined in two ways by Hoffman (2003), initially as

online functionalities provided for rent to consumers in order to help them solve their problems and meet their needs and secondly as the "machine to machine provision of software functionality, potentially provided outside of human interaction or perception". This doctoral thesis follows the first definition of electronic services. When electronic services are examined from the Information Systems (IS) perspective the technological applications and solutions that provide and provision these services belong to e-commerce if there is the use of the Internet (Pavlou 2003; Vrechopoulos et al, 2004) or m-commerce in the case there is the use of mobile or handheld devices (Mylonopoulos and Doukidis 2003).

In the era of electronic services, recently the trend of gamification has found its way as another medium that is promising to support the creation of advanced electronic services (Guang Shi. et al. 2017) and as such in the academic literature, gamification is starting to gain momentum the past seven years and its roots can be found in games. To better understand gamification it would be necessary to first understand and conceptualize games and play. Going back to traditional theorists of games and play, Roger Caillois coined the terms Paidia and Ludus which map to playing and gaming in his seminal book "Man, Play and Games" (Caillois, 1961). According to Caillois, Paidia is an uncontrolled play with different aspects of improvisation, exuberance and carefree gaiety where Ludus restricts play with "arbitrary and tedious conventions" adding "gratuitous difficulty. Therefore gaming involves a structured game that is competitive in nature and has a clear goal or purpose whereas playing is a free form, open ended and unstructured activity that has no particular goal or purpose. Evolving from Caillois, games have been defined as activities that have voluntarily participation which are bounded by rules and require conflict among equal parties towards unequal end results (Avedon and Sutton-Smith, 1971). Going to the contemporary digital games realm, noted game designers Salen and

Zimmerman define games as “systems in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome” (Salen and Zimmerman, 2004). Stemming from games and as gamification is a relatively new field of inquiry, different research streams employ different definitions in relation to the point of view they examine it and the respective domain of application. Gamification, when viewed from the service marketing perspective has been defined as “a process of enhancing a service with affordances for gameful experiences in order to support a user’s overall value creation”, by Huotari & Hamari (2012), emphasizing on the overall goal of gamification and placing the focus on the user experience, rather than the end produced service. When gamification is viewed as a tool for business strategy Werbach and Hunter define gamification as “[the] use of game elements and game-design techniques in non-game contexts” (Werbach and Hunter, 2012) suggesting that gamification is a process of designing services or systems as a designer would. From the educational perspective Lee and Hammer (2011, p.1) define Gamification as the “use of game mechanics, dynamics and frameworks to promote desired behaviours” and on the same field Kapp (2012) defines gamification as using “game based mechanics, esthetics and game thinking to engage people, motivate action, promote learning and solve problems”. In the gamification literature, to date, the most cited definition derives from the seminal work of Deterding et al. (2011) who define gamification as “the use of game design elements in non-game contexts”. The aforementioned application of game design elements is conducted with a specific goal in mind on the part of the gamification designer. In particular the elements of “gamefulness, gameful interaction and gameful design” (Deterding et al. 2011, p10) refer to the experience (gamefulness), the game elements (gameful interaction) and the process of creating a gameful experience (gameful design). This definition also poses a separation of gamification from fully fledged games as it distinguishes between gaming and

playing as well as whole games and utilization of parts of games (Figure 2), also positioning gamification in the larger field of the ludification of culture (Figure 3).

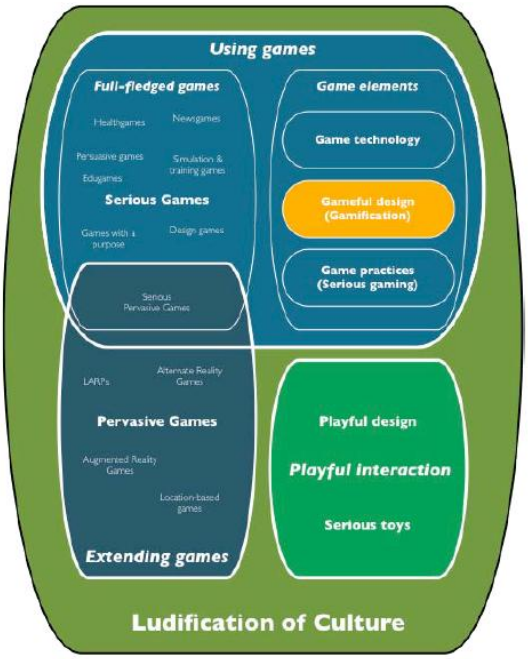


Figure 2: Gamification in the larger field of digital games (Deterding et al. 2011)

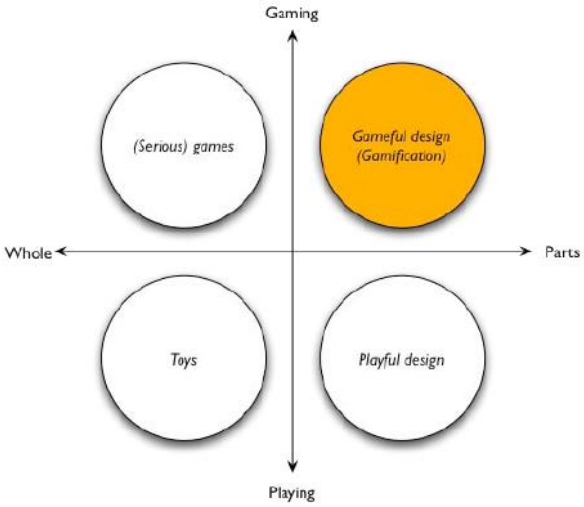


Figure 3: Gamification contrasted with related concepts (Deterding et al. 2011)

Going back to Hamari's et al.(2012) definition of gamification where gamification is "a process of enhancing a service with affordances for gameful experiences in order to support [the] user's overall value creation" when designing a gamified service, the entity that will offer the service can utilize the affordances for gameful experiences (i.e. the different game design elements from Deterding's definition, dynamics and aesthetics of gamification) in order to achieve the business objectives (Werbach and Hunter, 2012).

Gamification as the *"*of game design elements in non-game contexts*"* (Deterding et al.,2011) currently has been applied in a number of non-game contexts, namely domains with a varying goals. Examples of gamified services can be found in domains as *Education* (Smith and

Baker, 2011; Foster et al. 2012; McDaniel et al.,2012; Cheong et al., 2013; Denny, 2013; Dominguez et al, 2013), *Health and Wellness* (Hamari and Koivisto, 2013, Hori et al.,2013; Rose et al.2013), *Sustainability* (Gustafsson and Bang, 2008; Liu et al. 2011; Gnauk et al.,2012; Berengueres et al.2013), *Marketing and Commerce* (Downes et al., 2012; Terfutter and Capella, 2013; Hamari, 2013), *Computer Science and Engineering* (Farzan and Brusilovsky, 2011; Passos et al., 2012; Fernandes et al.,2012) and *Human Resources work training* (Farzan et al., 2008). The varied applications of gamification in the different domains include the introduction of the different game design elements into different scenarios with varied goals. A common denominator of the different applications is that they rely on game design elements and their interplay.

2.1.2 Game elements and Gamification Design

In order for gamification to be enabled the game elements as gamification "atoms" (Deterding et al.2011) are utilized in combination to form a gamified system which in turn is applied to the non-game context's participants. Extant literature provides a set of base game elements that can in combination constitute a gamification design like points, badges, leaderboards, rewards, levels, quests and challenges amongst others (De Paoli et al. 2012; Dominguez et al. 2013; Zichermann 2011) to enable the transformation of a given non-game context into a gamified one.

2.1.2.1 Game elements

The base game elements found in gamified services include among others Points, Badges Levels / Status, Leaderboards, Missions / Challenges / Quests, Rewards, Achievements and Gamification feedback. *Points* are arithmetic units used to keep track of each participants' score

as a result of success in a predefined and specific task. Participants can earn points through conducting activities that are available in the gamified process. Subcategories of points include: Experience points – XP that are obtained continuously, Redeemable points - RP that are of the type of "earn and burn" for external rewards, Karma points - KP that are awarded from a player to another. (Kuo and Chuang, 2016; de Rocha Seixas et al., 2016; Cheong et al., 2013; Eickhoff et al., 2012; Thom et al.,2012; Farzan et al., 2008). *Badges* are visual representations of achievements in the gamified tasks of the electronic service. They can serve as an indicator of accomplishment from the system to the participant as well as a representation of status from participant to participant. (Davis and Singh, 2015; Hamari, 2015; Antin and Churchill, 2011). *Levels* are predefined sets of bundled actions that are of different difficulty to be completed (usually progressive upwards in diffi-culty) and Status can be obtained upon progressing and completing each Level. Through the employment of levels, the gamified structure can guide the evolution of skill and mastery of the participants in order to enable them to experience optimal challenge (Mutter and Kundisch, 2014; Dominiques et al., 2013; Dong et al. 2012; Farzan et al., 2008). *Leaderboards* are ordered lists of the current ranking of participants. The formation of the leaderboard can be in various forms dependent on the case: (a) infinite leaderboard with all participants being visible, (b) a non-disincentive leaderboard where each player can see his/her relevant position in the center and 1-3 users predating him/her and 1-3 following him/her. (c) Slice&Dice leaderboards where the leaderboard is sliced based on contextual factors such as location, social among others (de Rocha Seixas et al., 2016; Hanus and Fox, 2015; Landers et al., 2015; Butler, 2013). *Missions* and *Challenges* enable the players to go through a structured and self-contained set of tasks and training content. They can be embedded within levels to micro-manage skill evolution of the player. Both can be used to ensure parallelism to the user goal at

hand and constitute small steps that build up to the bigger goal of the gamification setup (de Rocha Seixas et al., 2016; Zichermann and Cunnungham, 2011). *Rewards* are in-gamification and out-of gamification end goals for the participants. Two main categories of reward are Virtual and Physical based on the point of application. Virtual rewards are stemming and contained within the game space. Physical rewards transcend to the real world. A badge is an example of a virtual reward where monetary rewards are physical rewards (Lounis et al., 2013; Li et al., 2012; Fitz-Walter et al., 2011; Liu et al., 2011; Montola et al., 2009). Lastly, *gamification feedback* on all actions is considered important. Additionally to the general feedback mechanisms, that keep the user on the predefined path, the granular display of current stand and upcoming actions until completion enables engagement with the content. The application can be in the form of a progress bar within Quests, Challenges etc. or an overall goal progress bar (Xu, 2015; Dong et al. 2012; Li et al., 2012; Richter and Raban, 2012; Gustafsson et al., 2010). Besides the aforementioned base game elements found in most gamification solutions, over seventy different game elements can be used in the process of gamifying a system, for example through the Octalysis Framework proposed by Chou (2013). This plethora of game elements can be mixed and matched to create different gamification designs that can be later employed to serve the goal of the gamification task or non-game context.

2.1.2.2 Frameworks enabling the gamification of electronic services

In order to design a gamified service, a number of gamification frameworks have been lately introduced to assist in the process. Di Tomasso's "*Framework for Success*" (2011) includes seven steps towards gamifying an activity based on Self-Determination Theory. The steps towards gamifying an activity include: (1) Discovering the reason for the gamification based on stakeholders' and business objectives, (2) Identification of the profiles and motivational

drivers of the potential participants, (3) Goals and Objectives setting, (4) Identification of players skills and Actions relevant to the skills, (5) The "Lens of Interest" where the choices of game elements introduction and interaction occurs, (6) Desired outcomes identification, and (7) Playtesting.

Another gamification framework is *Six Steps to Gamification* known as 6D by Werbach and Hunter (2012). In 6D the process of gamifying and activity starts from the initial identification and definition of the business objectives followed by the delineation of the target behaviour noting of what is the desired outcome on the business objectives. The third step includes the analysis of the players (potential participants) and their key characteristics. The fourth step is the selection of the "activity loops" which is the structure of the interactions of the game elements among them and the game-elements to player interactions. The fifth step includes the analysis of the design choices in terms of whether they have the potential to be perceived as "fun" by the participants. Lastly the sixth step includes the deployment of the gamified system and the play. Marache-Francisco and Brangier (2013) propose a Gamification design process rather than a framework consisting of three dimensions that need to be taken under consideration when designing a gamified system, namely Sensory-motor dimension, Motivation emotion and commitment and Cognitive dimension of interaction. Theses dimensions are included into two steps of gamification design, the context analysis and the gamification experience. Lastly the *Octalysis Gamification Framework* by Chou (2013) emphasizes on the design from the point of view of the participant and the motivational drives that can be employed to facilitate motivation for engagement. The game elements are placed on an octagon shape where they are mapped to the eight core drivers identified namely, Meaning, Empowerment, Social Influence, Unpredictability, Avoidance, Scarcity, Ownership and Accomplishment. The aforementioned

generic gamification frameworks although are utilized as gamification design frameworks in the industry, little work is extant in the academic literature in terms of validating the aforementioned frameworks (Deterding, 2015). However, domain specific gamification frameworks are developed and examined by the academia in different fields. In the domain of education and with the purpose to assist educators with a set of gamified educational tools to improve motivation and learning outcomes of students, Simoes et al., (2012) developed a Social Gamification Framework for K-6 learning platforms. In their framework, game elements of points, levels, trophies, rewards and leaderboards are adapted to the K-6 education context and a teacher is enabled to deliver his/her learning content in a gamified learning process as illustrated in Figure 4. The K-6 Framework for Social Gamification is undergoing examination in the context of the Schoooools.com project involving 18000 users in 54 schools in Portugal.

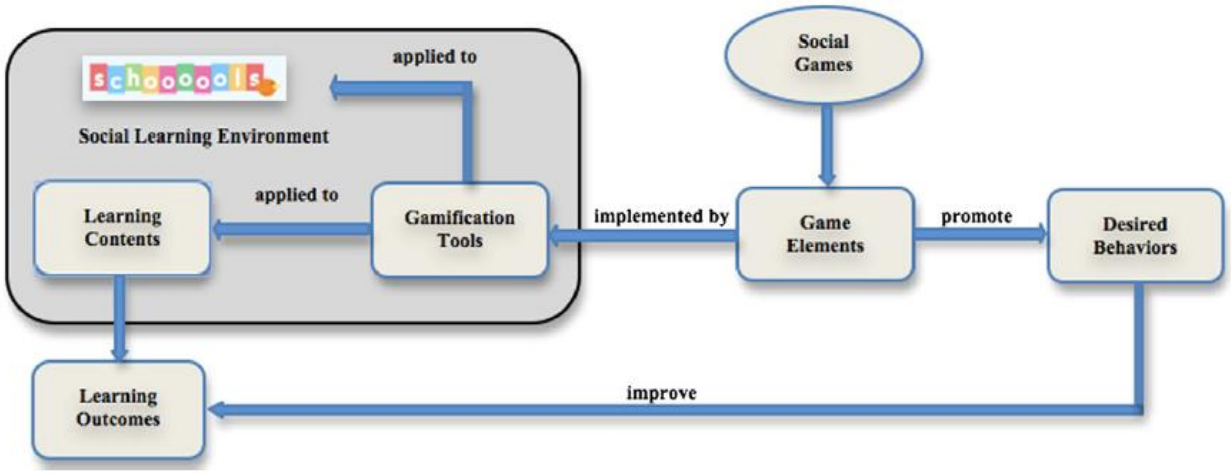


Figure 4: The K-6 Framework for Social Gamification (Simoes et al.,2012)

Another domain specific gamification framework in the E-Banking sector is proposed by Rodrigues et al. (2016) where the developed framework was presented and experienced by 53 participants that yielded five characteristics of the gamified software development (design, appearance, functionality, rules and objectives) as well as five element dimension (game,

product, security, process, and information) leading to a framework for designers that highlight the most important features that the gamified system should have. The framework was evaluated through five gamified business applications, namely (Futebank, Dreams, Galaxy, Olympics and Warrants). These applications were presented to five respective user groups in the study to identify the software elements and characteristics that were perceived by the users as relevant to the gamification process. The results, as illustrated in Figure 5, present a Five-Step project management framework for gamification (5PMG) that can serve as a framework towards the design of gamified systems in the E-Banking Sector.

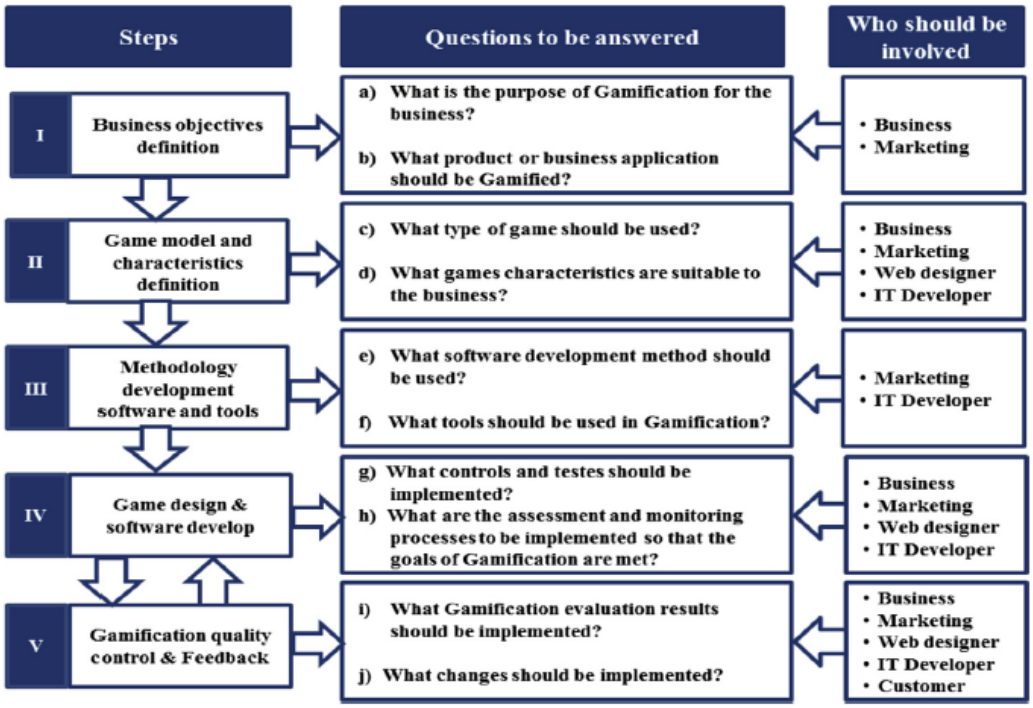


Figure 5: The 5PMG Framework for gamification in the E-Banking sector (Rodrigues et al. 2016)

In the domain of Software Engineering, the GOAL Framework by Garcia et al. (2017) provides the designers with a framework that addresses all phases of the software life cycle as well as the processes involved in each phase. The methodology followed in the GOAL

Framework, includes 6 steps namely Identification of Objectives, Player analysis, Scope definition and feasibility study, Game analysis and design, Development of Gamified platform and Management, monitoring and measuring as illustrated in Figure 6. In the first step, the objectives and the indicators of objective fulfillment are established, followed by the second step where the potential players' profiles are obtained and analyzed in parallel to the objectives. In the third step the gamification design occurs within the scope of the gamification objectives and an overall feasibility study shows identifies the best solution for the solution to be developed. In the fourth step the requirements are produced per component, mechanic, dynamic and aesthetic and the use cases are produced. Fifth step includes the development of the gamified system on the use cases and lastly the platform is monitored and refined on the game elements, dynamics and mechanics of the system. The framework was applied in a software company employing 25 people though a case study with positive results in the areas of project management, requirements management and testing.

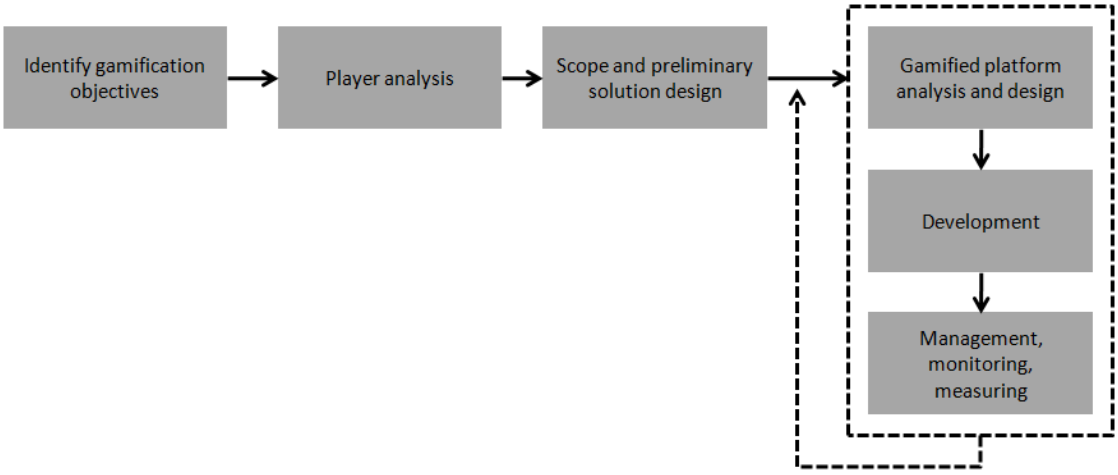


Figure 6: The GOAL Framework methodology (Garcia et al., 2017)

As gamification is a relatively new and unexplored field the identified gamification frameworks are either not validated (Deterding, 2015) or the ones that adhere to specific domains or developed for specific purposes do not adequately cover the intricacies of other non-game contexts. In order to negate the issues that may arise from the utilization of a gamification framework that is either not examined extensively or does not relate to a non-game context of research it is prudent to refer to game design frameworks that can be found in the game design literature as Bjork and Holopain (2004) Patterns of game design, the Typology model of game design by Elverdam and Aarseth (2007) holding seventeen dimensions that should be considered by the game designer when creating a game, Salen and Zimmermans' (2004) conceptual framework proposing three ways to frame and understand games namely Rules, Play and Culture where Rules address to the formal game design, Play addresses the experiental design and Culture contains the contextual game design. The aforementioned game design framework and typologies are designed for the creation of fully fledged games and although can be used as an initial starting point towards gamification design, they extend at cases beyond the scope of gamification in terms of the plethora of design choices (e.g. Elverdam and Aarseth 17 dimensions) or do not account for the non-game contexts' business goals of gamification and the necessity for an open-ended gamification design as gamification may not have the end structure found in games.

On that account, in gamification and stemming from the game design literature, a widely adopted framework is the *Mechanics, Dynamics, Aesthetics (MDA)* Framework by Hunike et al. (2004). The MDA framework, stands for Mechanics, Dynamics, Aesthetics Framework and is a game design Framework that consists of three levels of abstraction that support the creation of a game in iterative stages based on the available game components and the potential interaction of

player to the components and subsequent result from the player side, in contrast to the expected result from the producer side. In the MDA Framework, as defined by Hunike et al. (2004, p.2), Mechanics are "the particular components of the game, at the level of data representation and algorithms", Dynamics constitutes "the run-time behaviour of the mechanics acting on player inputs and each others' outputs over time" and Aesthetics is the "desirable emotional responses evoked in the player, when she interacts with the game system" and the two way interaction starting from the designer perspective and design choices on the one hand, and the user percpective that follows a different path where (s)he experiences the gamified service through the aesthetics to the Dynamics and the Mechanics. The MDA Framework is presented in Figure 7.

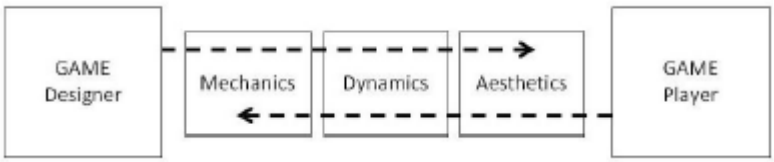


Figure 7: The MDA Framework (Hunike et al. 2004)

Following the Gamification paradigm and using the MDA framework as a conceptual starting point, we are able to utilize the game elements into gamification designs having in mind that the process relies both from the designer perspective towards creating an experience that aims to elicit aesthetic results but also from the participants' perspective who based on the aesthetic result identifies with the gamified system. The MDA Framework is suitable for gamification of contexts as it elicits three different levels of abstraction in the game design process and creates a roadmap to examine the relationship between game elements eligible for introduction (stemming from Mechanics), rules of interaction in the particular context (stemming from Dynamics) and reason for introduction based on expected evocation of emotional responses

(stemming from Aesthetics). In the MDA Framework the Aesthetics level elaborates on player's potentially evoked emotional responses through a specific taxonomy that includes "Sensation, Fantasy, Narrative, Challenge, Fellowship, Discovery, Expression and Submission" (Hunicke et al. 2004, p.2) differentiating from terms as "Fun" and "Enjoyment" which are traditionally shout after in game design. However, as Gamification is still under development, it is prudent to treat the aesthetic component of gamification through the motivational affordances sought after by the designer and experienced by the participant. In a gamification setting the mechanics available include the game elements of gamification, and Dynamics constitutes, the interaction of the users with the game mechanics. Lastly the aesthetics constitute the desired evoked emotional response upon experiencing the gamified context through the designed service.

2.1.3 Gamification design effecting Engagement and Performance

Gamification has received the attention of the academic literature in the past five years and attempts to identify its benefits are undergoing. Initial efforts have focused on the identification of the effect of different gamification designs on different non-game context by means of transforming them into gamified activities and examining the effects the transformation had. However these efforts are mainly focused on specific implementations of gamification examining post-gamification changes in participant behavior. What's more the gamification designs employ and examine different game elements, in parallel as whole. In their review, Hamari et al. (2014) examined 24 empirical studies on gamification and identified that across the different research efforts the gamification designs employed as well as the outcomes examined varied greatly between the studies to the degree that formal meta-analysis could not be conducted as they were not comparable. Additionally they identified that out of the 24 empirical studies, only two had positive results on all tests and 13 had parts of tests yielding positive results. Lastly

only five papers examined the effect of an isolated game element whereas the remaining had varied game elements under different gamification designs. In another effort to identify the merits of gamification and its effectiveness as a motivational tool, Seaborn and Fels (2015) examined 31 empirical papers on gamification in different domains and found similar results. In particular, they identified that out of the 31 empirical studies, 19 yielded positive results and 12 yielded mixed results. Out of the 31 empirical studies only 5 papers examined the effect of isolated game elements and the remaining had different combinations of game elements under gamification designs. Additional to cross domain examination of the benefits of gamification, recent studies surveying the literature of gamification can be found that are domain specific. In the field of Software Engineering, Perdreira et al., (2015) conducted a systematic mapping of gamification in software engineering identifying 29 papers in the field, however less than half of the papers included empirical evaluation. In a similar manner, Sardi et al. (2017) surveyed the literature on gamification and e-Health identifying 41 articles out of which thirteen examined gamified applications with the aim to sustain users' engagement with the designed e-Health related tool. Similar to the previous studies the gamification designs varied and utilized a plethora of different game elements in the respective studies, which lead the researchers to identify the need for further empirical evaluations as means to provide validity of gamification's effectiveness in the domain.

In terms of *engagement* with a gamified system on a non-game context indicative studies employing different gamification designs with a collection of game elements present results varying from positive to mixed. Li et al. (2012) utilizing challenges, levels, rewards, points, badges and leaderboards, created GamiCAD a gamified tutorial system for learning AutoCAD. In their study the utilization of the selected game elements under the gamification design

supporting GamiCAD yielded in positive results on the engagement of the users with the system. Dominigues et al. (2013) similarly utilized a gamified design employing levels, challenges, badges and leaderboards in the education field in order to increase students' motivation and engagement in learning experiences. The results of the application although revealed an increase in initial motivation, poor written performance and participation in class was observed. Another interesting outcome of gamification is presented in the study of Cramer et al. (2011), where with the use of points, badges and status, the researchers aimed to encourage location sharing utilizing Foursquare. The results indicated that although the game elements could engage the participants with the gamified task, at cases they were demotivating. On the other hand of positive or partially positive results, Downes-LeGuin et al., (2012) found that engagement was unaffected by the gamification design employing narrative, levels, avatars and rewards, in the field of Marketing. This differences on the effect of gamification designs in engagement is consistence with the findings on performance. In terms of *performance* on the given task(s) of the non-game context with the utilization of gamification designs, a number of studies present interesting results. McDaniel et al. (2012) utilized a gamified design employing badges and leaderboards on online communities as means to enhance interactions. However the results of the gamification were mixed and performance was modestly affected by the gamification design. In an effort to encourage participation in pro-environmental community activism through crowdsourcing, Masson et al. (2013) utilized the game mechanics of points, badges and leaderboards with mixed results as the gamification design was found to increase the performance of the participants however not significantly.

Although the primary focus of the academy has evolved around examining the effect of gamification as a whole, as the field matures, different research streams shout after to examine

the effect of individual game elements on the gamification goal. Such game-element isolated examples of gamification research can be found in badges, levels and rewards. Denny (2013) examined in isolation the game element of badge as means to motivate participation in online multiple choice question based learning system. Results indicated that badges had an effect on the engagement with the learning system however the number of submitted questions (performance) was not affected. Passos et al (2011) utilizing medals (badges) in a study of a gamified software development method presented mixed results with parts of the sample individuals and teams becoming more engaged than others.

Snyder and Hartig (2013) examined the effect of the game element of rewards on an online quiz system for medical residents and results showed an 80% participation in the system as well as a 70% correct response rate leading the researchers to speculate that the gamification design employing rewards contributed to the engagement with the system. Musthag et al. (2011) utilized the game element of rewards to motivate individuals to engage in submitting quality data in research studies. Results indicated that the reward incentive structures improved performance in the gamified task. Lastly in an effort to utilize gamification to encourage participants to smile more Hori et al. (2013), utilized the game element of levels yielding positive results where participants in the study showcased an increasing number of smiles. Although research on individual game elements yields positive results in most cases, gamification design usually does not rely on a single game element but employees more in combination.

2.2 Preliminary Research

This doctoral research was also motivated by the identified gaps found in two different cases of gamification of electronic services in two different non-game contexts. The first pertained to a service with the goal to enable utilities and companies to motivate end users to

consume energy (at home and at work) in an environmentally conscious way and the second pertained to the design of a gamified service for the collaborative authoring of interactive applications for children. The two cases alongside with the respective insight that complement the identified research gaps in current practices are briefly presented in the following sections.

2.2.1 Gamification of an Energy Efficiency Electronic Service

The first case that motivated this doctoral research, by identifying the need of individual game element examination as well as the introduction of the end-user in the design process pertains to the design of a gamified service targeted to energy efficiency in the workplace for an SME company in the field of energy efficiency. The company offers an electronic service that enables the real time monitoring and reporting of energy consumption, based on smart energy metering devices and targeted to businesses. The overall goal of the SME for the project is to provide a unified service that besides the main functionalities of monitoring and reporting, and subsequent benefits (e.g. cost reduction) will offer advanced services aimed at the employees of their business customers. This advanced service will support the employees of their customers towards adopting energy efficient consumption practices in the workplace and included the introduction of gamification in their core offering. The goal of gamification in the present case was twofold : (a) To motivate for engagement with the solution with the introduction of a playful layer of interaction and (b) To educate the end-users in the benefits of adopting energy efficient practices in the workplace. In the process of designing the gamified service to be introduced in the core electronic service of the SME a number of phases took place each of which resulted into valuable insights that guided this doctoral research. The design phase of this case included the phases of Business requirements elicitation, Design of gamified service and playtesting prior to deployment.

Initially and pertaining to the requirements elicitation, the identification of the goals of gamification were business driven and evolved around the capabilities of the extant service solution. In order to enable the enhancement of the service with a playful layer of interactivity a number of game elements were introduced in the resulting gamification design that aimed to cater to the different levels of the respective employees. Additionally as there was a business goal to train and educate the employees in the benefits of adopting energy efficiency practices at work a separate set of quizzes (with energy related content) was deemed fit for introduction. As the business goals of the gamification of the electronic service were predefined and business driven, the option to engage the end-customer businesses that would eventually benefit from the system and introduce them into the design process was not possible. The aforementioned inability had both benefits and drawbacks. The main benefit was that the gamification design would not be too narrow or limited in scope as it would not be bound by an additional layer of customer specifications. As the electronic service is offered in a plethora of businesses in different industries, the introduction of their respective requirements would create a gamified service that although would cater greatly to their individual intricacies, would render the design complicated and inapplicable horizontally. The gamified service was therefore a white label gamified electronic service in the field of energy efficiency.On the other hand a drawback that stems from the inability to introduce the end customers in the design phase led to the creation of a gamification design that would not be focused to the specific customers' needs limiting its potential per deployment.

During the requirements elicitation phase and pertaining to the goals of the gamified service the two main goals were analyzed to identify in the literature the most prominent game elements in parallel to the best practices in the industry at the time. The base game element of

point was selected to be utilized as the main building block upon which successful interaction would be rewarded. In particular for points and in order to cover all possible aspects of potential rewarding different subtypes of points were selected. The base Experience Points would cater to in-gamification service results of the end-user actions, whilst interacting with the service. Additionally the type of Redeemable Points would enable the gamified service to provide physical rewards (i.e monetary bonus). The aforementioned point structures in turn enabled the introduction of the game element of a leaderboard in order to present to the users their current stance in the global energy efficient efforts. Further on, as one of the goals of the service was to enable the training of end-users in energy efficient work behaviours, the game element of levels was introduced in order to segment the energy efficiency knowledgebase of the company into levels of training content, served via different questionnaires. Complementing the point awarding structures and the leaderboards and levels, badges were selected to represent discreet milestones of achievements. Badges were developed around the theme of energy efficiency as to enable their industry agnostic application. Lastly for all available actions that were enabled in the gamified service, respective sets of KPIs were developed to enable the monitoring of the behaviour of the end users as well as to be used further on to optimize the gamified service. During the design phase a number of iterations took place with the SME in order to conduct an initial finetuning of the game elements' allocation to the different energy efficient content that would cater to the non-game context at hand. Lastly during the playtesting period the developed smartphone application was examined for the appropriate introduction of the game elements. Following the completion of the project, the SME proceeded to deploy to several of its customers supporting their core offering and presently it has evolved since its first version to a more complex system.

The present project resulted in valuable insights pertaining to the design of an electronic service. An initial major finding relates to the overall process of requirements elicitation. As the system was designed solely upon the specifications provided by the SME, the design had an additional layer of complexity in order to be enabled to cater to the varied potential applications on different industries. Further on as no end users were brought in the design process a core drawback was that the design was based only on industry best practices and the current literature at the time. This presents a clear drawback of the gamified electronic service as the end-users who the service is target for were not introduced in the design process leading to a gamification design that was not tailored to their needs. As such the present research benefits from the insight received towards validating the *need for the introduction of an additional phase in the requirements elicitation phase, that of introducing the end-users in the process.* Another important insight relates to the combination of the game elements. As the service was designed to be offered as a package, a large number of KPIs were needed to be introduced in the backend in order to be able to identify which game elements engaged the users. Further on, as the system did not have the ability to be customized per instantiation, regarding the game elements, during deployment and operation it lacked the ability to conduct an experiment to identify the effect of isolated game elements and the results from its usage would refer to the gamified service as a whole. This presented the need for an experimental phase for the validation of the gamification design decisions pertaining to the game elements introduced.

2.2.2 Gamification of a Collaborative Authoring Electronic Service

The second case that involved the gamification of an electronic service and produced valuable insight that guided this doctoral research pertains to an electronic service in the field of collaborative authoring of interactive apps and e-books for children, named Q-Tales. Q-*Tales is*

a collaboration ecosystem where creative professionals, experts and parents co-create new (or transform existing) children literature into high quality interactive e-books. In order to achieve that, the Q-Tales Collaboration Platform brings together the aforementioned stakeholders and subsequently through the Q-Tales Authoring tool the interactive e-books are co-produced. Following that, the Curation Framework ensures that every produced interactive e-book conforms to the academic developments of pedagogy. Lastly, the Q-Tales interactive e-books are made available through the Q-Tales store for parents to purchase and for their children to read. This novel approach in the process of self-publishing extends the currently available options and enables creative professionals in the industry to become involved throughout the lifecycle of the process of new interactive e-books for children creation and publishing. The Q-Tales ecosystem's architecture is presented in Figure 8.

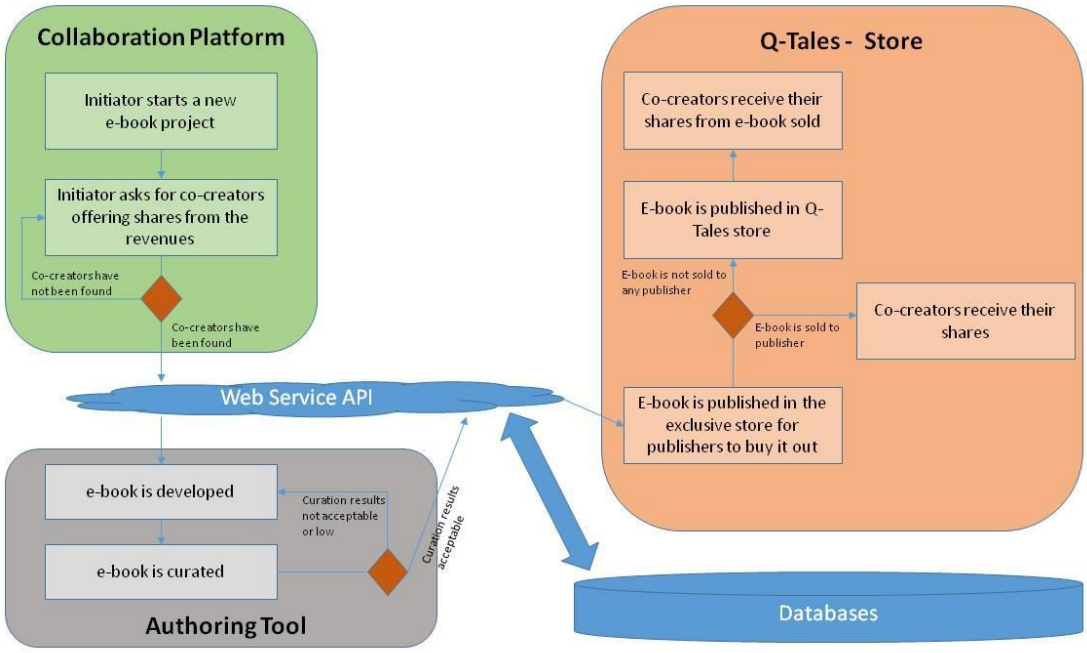


Figure 8: Case #2 The Q-Tales architecture

As this new approach of self-publishing is disruptive in the very nature of current publishing practices and approaches, in order to motivate professionals to participate and adopt it, the gamification paradigm was employed, turning the Q-Tales ecosystem and respective processes into game-like experiences. In the present case as the involved stakeholders were different in nature the need to introduce them in the gamification design process was evident as the gamified system we designed was indented to be used by a number of different professionals and individuals in the spectrum of interactive e-books for children including Educators/Teachers, Parents/Children, Authors/illustrators/Narrators among others. The choice to introduce and apply gamification was a result of the two major workshops conducted in Italy (Rome) and Poland (Cracow) where stakeholders from all user groups relevant to Q-Tales' scope participated in the design process that resulted in the extraction of the platform and gamification goals, as well as guidelines for the game elements eligible for introduction in the Q-Tales ecosystem"s modules. More specifically, the workshop held in Rome, Italy, involved 18 participants including 7 educators, 2 parents" organizations, 3 researchers, 3 technology developers, 2 pedagogists and 1 bookseller and was focused on the platform itself. Stakeholders were asked to identify potential barriers from their perspective to the realization of the Q-Tales platform and of e-books generation, which then were incorporated in the gamification design of the platform. For instance, a main issue identified was the "Need to encourage creators, producers, publishers, schools to continue to use the platform", which should be resolved by the introduction of game elements, such as missions, badges and leaderboards. Furthermore, the workshop held in Cracow, Poland by the Cracow Chamber of Commerce and Industry had the form of a focus group, in which participants focused on the barriers to childrens' literacy development. In total, 12 participants from a variety of backgrounds including educators, reading specialists, authors

and publishers were asked in a focus group context to openly discuss potential implementation barriers. The main results related to gamification were:

(a) Experts agreed that achievements gained by profile/avatar could motivate to reading

(b) Children should be rewarded for trying, not just for success

(c) Introduction of mini games with make the reading process more interactive and engaging

Following the identification of the gamification goals of Q-Tales, the introduction of different game elements that would cater to the different goals and the respective stakeholders took place. In Q-Tales the game elements introduced were Points, Ranking, Leaderboards, Badges, Missions and Feedback. In Q-Tales, the main game element available across the service's modules is Points and in particular Experience Points and Karma Points. Points are utilized throughout the ecosystem to enable the stakeholders to track and showcase their performance in terms of system use and e-book creation results. Overall, the point structure follows different formations for each group of end-users as derived from the available functionalities of the systems they employ and have access to. In Q-Tales there are *31 point-awarding actions* distributed among the different components and available to respective end-users. The relative weight of each action and subsequent experience points awarding stems from (a) its importance to the ecosystem and (b) difficulty to be completed, as identified by the involved stakeholders of the platform and the end-users in parallel to Gamification best practices and academic literature. Additionally to point awarding actions and associated point rewards, and in the process of a professional's selection of the best possible complementary professional to collaborate, the Q-Tales ecosystem includes the game element of leaderboard. The leaderboards indicate the ranking of each professional involved in completed interactive e-books. The

leaderboard is customizable with the ability to present Ranking by Profession, Country of origin, Genre of published books, Age Range of published books and Curation score. In addition to the leaderboards and in order to further drive participants to engage with the system, a series of achievement milestones is introduced in the gamification structure. These achievements are represented with the use of badges, awarded in perpetuity to end-users upon completion of specific tasks related to milestones and the user group. Overall, 88 different achievements were identified and badges were designed to represent them. In order to enable the end-users to achieve higher levels of status based on their achievement the badges have three different levels (White, Silver, Gold) representing different importance and difficulty of achievements. Another game element introduced in the Q-Tales ecosystem, is the game element of missions. Missions are utilized in terms of the formation of specific challenges for the creation of different types of books. As the Ecosystem progresses and interactive apps and stories are created, missions will drive the creation of various stories that are required to complement the categories in the Q-Tales store. Initially, a set of Missions is introduced with the same constant reward (in terms of points) throughout and based on the progression of book creation, different missions will be constantly introduced to balance the overall need for different types, story genres, story characters etc. The set of initially introduced missions consists of 62 different missions all awarding 1000 Experience Points. The user is awarded the points if he/she has begun a new project through a mission and has successfully passed all the stages up to publishing. Lastly, for every action that triggers an awarding rule (for points/badges etc.) within the gamification framework, feedback is given to the user on the in-gamification result of his/her action. That is conducted by a popup that enables him/her to understand and follow his/her actions and the respective gamification reaction and reward. Additionally, the end-user is given access to his/her gamification related

results history where in reverse chronological order all rewards/achievements etc. are presented. This enables the user, in a non-intrusive or work-disruptive way to be informed on what is currently achieved and which is the next milestone throughout the process.

During the phase of initial deployment, the results from a period of a three-week trial showed that the gamification design and selected game elements were well received by the users with one exception, that of the leaderboard. Overall the leaderboard was found to be demotivating in terms of intention to continue using the ecosystem, amongst professionals and in particular the segmentation based on professionals' type. As the Q-Tales ecosystem enables the collaboration of professionals in the children e-book industry, during the requirements elicitation phase it was identified that the professionals would be interested to see and show where they stand among same industry professionals as means to be preferred in upcoming collaborations. This differentiation led to the removal of the different types of leaderboard and the maintenance of a single leaderboard based on overall Experience Points, which illustrates cumulatively the overall involvement of each participant with the ecosystem irrespectively of profession.

The involvement and results in the Q-Tales case, lead to important insights that motivated this doctoral research in a two-fold manner. Initially the game element of the leaderboard presented both positive and negative results in terms of potential to motivate end-users to engage with electronic service when introduced in a gamification design. During the requirements elicitation it was perceived as a positive measure to engage the end-users, however in practice it had the opposite effect. Additionally the need to conduct a thorough experimentation phase prior to the initial deployment of the gamified electronic service as means to examine in a real usage scenario was identified.

2.3 Research Gaps and Questions

Building on the findings of the literature review and the preliminary research on the two cases, it is evident that gamification of electronic services is still vastly under-examined and further research is required to identify the benefits of gamification in the different non-game context and further more the role that each game-element plays in the overall goal of the respective gamification design. Therefore a prominent overall research question entails to the combined effect of game elements and their interplay and role on the gamification design.

RQ1: What is the individual and combined effect of game elements in the behavioural outcome goals of a gamified electronic service ?

Additionally to the game elements and their potential contribution to the goals of a gamified electronic service, in the latter years an interest on understanding its motivational dynamics has begun and gamification is being examined under different motivational theories for its capacity to support or motivate the participants with the use of different game elements under gamification designs. In particular, the gamification is conceptualized in extant literature into three main aspects, the gamification design initially that includes the game elements and design as gamification affordances leading to the psychological outcomes sought after by the participants and last the behavioural outcomes that are enabled by the psychological outcomes (Figure 9).

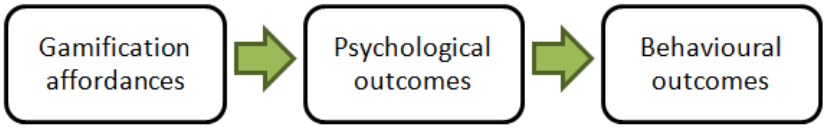


Figure 9: Abstract conceptualization of gamification according to Hamari et al. (2014); Huotari

and Hamari (2016).

Hamari et al. (2014), in their review of the gamification literature identified that the extant studies investigating the psychological outcomes of gamification focused on motivation, attitudes and intentions towards the services and enjoyment during participation, however at the time only one study utilized "validated psychometric measurements" (Hamari et al.,2014). A similar result on the psychological outcomes was identified by Morschheuser et al. (2017), in their review of gamified crowdsourcing services and applications where out of the 26 reported empirical studies that examined psychological outcomes of gamification in terms of motivation, attitudes, enjoyment, appeal, interest and goals, initially the psychological outcomes of gamification were not measured in a common manner and only four studies used validated psychometric measurement instruments. Further on Seaborn and Fels (2015) in their survey of the gamification literature across different domains identified the need for examination of the effect of isolated game elements via the empirical exploration of theoretical underpinnings of gamification including motivation with validated instruments as means to create a comparable set of results. A similar trajectory is proposed by Pedreira et al. (2015) in the field of software engineering and gamification where they identified that the majority of the studies do not provide evidence on the effect of gamification on players' motivation.

Overall there is a sizable gap in our knowledge of the effect of the gamification design as to the psychological outcomes of the participation as well as the behavioural outcomes. What is more, besides the overall gamification design, the individual game elements as well as the combined effect of game elements on the psychological outcomes is still under researched. Therefore another prominent research question pertains to the combined effect of game elements

and their interplay and role on the aimed psychological outcomes of the gamification of a non-game context.

> **RQ2:** What is the individual and combined effect of game elements in the psychological outcome goals of a gamified electronic service ?

In order to identify and examine the motivational capacity of gamification, a number of motivation theories stemming from the field of psychology have been proposed (Aparicio et al. 2012; Nicholson, 2012; Blohm and Leimeister, 2013; Sakamoto et al., 2012) such as Self Determination Theory (Ryan and Deci, 2000) and Intrinsic and Extrinsic Motivation (Ryan and Deci, 2000), Situated Motivational Affordance (Deterding, 2011), Activity Theory (Vygotsky, 1978), Goal Setting Theory (Locke, 1968), Flow Theory (Csikszentmihalyi, 1990) and Fogg's Behavior Model (Fogg, 2009) with the most prominent being Self-Determination Theory (Deterding, 2015; Seaborn and Fels, 2014). Self Determination Theory by Ryan and Deci (2000) is a macro theory of human motivation that postulates that a person is motivated to conduct an bahaviour by an intrinsic motivation when (s)he is motivated by factors internal to oneself or by extrinsic motivation when (s)he is motivated by a separate to oneself factor. Both extrinsic and intrinsic motivation have been found to promote engagement and performance in tasks (Cerasoli et al. 2014) however only intrinsic motivation has been associated with psychological wellbeing as well as an increase in the extent of effort individuals put into the examined tasks (Cerasoli et al. 2014). As gamification finds its origins on games, Self Determination Theory is proposed as an appropriate motivation theory to study gamification as previous research on games identified it as an appropriate framework to investigate the motivational potential of games and video games in particular (Przynylksi et al 2010; Rigby and Ryan, 2010; Przynylksi et al., 2009; Ryan

et al., 2006, Yee,2006). In Self Determination Theory, three major human needs are postulated as means to achieve intrinsic motivation to conduct a behaviour, namely the need for competence, the need for relatednesss and the need for autonomy. The need for competence refers to feelings of efficiency and success one must be enabled to have during conducting an activity in a given environment (Vansteenkiste and Ryan, 2013), the need for relatedness refers to feelings of belonging and attachment in a social context one must exhibit while conducting an activity in a social environment (Deci and Vanseenkiste, 2004) and lastly the need for autonomy relates to the feelings of freedom and volition one should experience whilst conducting an activity (Deci and Ryan, 2012). Although Self Determination Theory has been identified as a prominent motivation theory under which gamification can be examined, little research is presently extant with the focus of identifying the potential of gamification to motivate participants on gamified tasks (Mekler et al. 2015) and further on little research is extant examining the motivational capabilities of individual game elements in isolation with the notable exceptions of Mekler et al. (2013;2015) examination of points, levels and leaderboards, Denny's (2013) examination of badges and Landers et al. (2015) examination of leaderboards. In order to identify the potential of different gamification designs to facilitate the three basic needs of competence, relatedness and autonomy, Sailer et al. (2017) proposed an initial taxonomy of game elements based on their potential to address the different needs. They propose that the need of competence can be addressed by Points, Performance graphs, Badges and Leaderboards, the need for relatedness can be addressed by Team formation and the need for autonomy can be addressed by avatars (Salier et al., 2017) leading to a research trajectory of examining the game elements in isolation as well as in combination as means to enable specific needs. The aforementioned identified gaps in the gamification research pertaining to the motivational capabilities of gamification and respective

game elements through the lens of Self Determination Theory present a prominent set of research questions as follows:

RQ3: What is the effect of game elements and gamification design on Perceived Competence, Autonomy, Relatedness of participants?

RQ4: What is the relation of the game elements to the interplay of the psychological and behavioural outcomes?

Chapter 3: Research Methodology

The research methodology is defined as the plan utilized for the systematic investigation of a selected phenomenon or behavior, whilst employing the scientific method according to Matsumoto (2009). As this investigation is relative to the way the topic is approached and the researchers' own beliefs and views, in order to design a research study one must navigate and position oneself through the three framework elements that comprise it (Creswell 2014). The three framework elements and approaches to research include: the philosophical assumptions about what constitutes knowledge, the strategies of inquiry (research design) and lastly the methods which are the detailed procedures of data collection, analysis and writing. Chapter three presents the philosophical stance and the methodological principals of this doctoral research.

3.1 Research Approach and Epistemological Considerations

In relation to the philosophical assumptions of what constitutes knowledge and the respective knowledge claims and worldviews (Guba 1990), a researcher can identify with one out of four main worldviews, namely Postpositivism, Constructivism, Advocacy/participatory and Pragmatism (Creswell, 2013) as a relation of her/his evolution in the course of the doctoral research and the subject one inquires about. *Postpositivism* (also termed empirical science, postpositivist research) stemming from 19th Century writers challenges the preceding positivist notion of the absolute truth of knowledge, postulating that "*we cannot be "positive" about our claims of knowledge when studying the behavior and actions of humans*"(Creswell, 2013). In this case absolute truth can not be found as knowledge is conjectural (Phillips and Burbules, 2000). Postpositivists believe that different causes probably determine effects and outcomes, therefore rely into breaking down the problem they study into discrete and testable ideas as means to

identify and assess the potential causes that influence the observed outcome. *Constructivism* on the other hand, assumes that the individuals in their effort to understand the world where they operate develop subjective meanings of their own experiences that they in turn interpret. In the course of searching of meaning the focus relies on the understanding and interpretation of the participants' views with the utilization of broad open ended questions that enable the subjects of the inquiry to share their views inline with the sense based on their historical and social perspectives (Crotty 1998). A third worldview is *Advocacy and Participation* where the philosophical views are influenced by different political concerns and the need is to improve the society and better the conditions of marginalized groups. In this worldview, the researcher collaborates with the individuals belonging in the groups that face injustices and inequalities in the course of the inquiry. Lastly, *Pragmatism* focuses on the problem at hand and its study and solution and not on the methods, therefore it is strongly associated with mixed-methods that inform the problem. The aforementioned four worldviews are comprised of different elements, on which they take a different approach. These elements represent different views on the very nature of reality (ontology), on the way we obtain knowledge (epistemology), the role of values in research (axiology), the research process (methodology) and the language of research (rhetoric) (Lincon and Guba, 2000; Creswell, 2003). Postpositivism subscribes to a singular reality ontology, where distance and impartiality is maintained by the researcher during the inquiry leading to an unbiased role of value. Researchers utilize a deductive methodology and report their results in a formal rhetoric. Postpositivism is therefore predominately characterized by quantitative approaches during the inquiry where based on theoretical statements, hypothesis are formulated around the problem at hand and subsequently tested through formal and commonly defined measurement constructs. Constructivism on the other hand subscribes to a

multiple realities ontology, where closeness is maintained by the researcher during the inquiry leading to a biased role of value. Researchers utilize an inductive methodology and report their results in an informal rhetoric. Constructivism is predominately associated with qualitative research methodologies employing analysis of narrative data as interviews and case studies (Creswell, 2014). Advocacy and Participation subscribes to a political reality, where collaboration with the different groups suffering from injustices is maintained during the inquiry leading to a biased and negotiated axiology. Researchers utilize participatory methodologies and report their results in a language that helps bring change to the participant groups. Lastly, Pragmatism subscribes to both singular and multiple realities where practicality as an epistemology leads to multiple stances in their role of values. Researchers combine qualitative and quantitative data and mix them and lastly their rhetoric on the reporting employees both formal and informal styles.

The purpose of this doctoral research is to design a gamified electronic service based on the examination of the way different game elements under a gamification design can affect the motivation of the participants to engage in a gamified activity and to examine the underlying factors of motivation on the behavioural outcomes. Therefore, the quantitative approach was chosen to test the effects of the game elements on participant behaviour and reach to a conclusion by a hypothetic deductive reasoning (Straub et al.,2005). That selection is in parallel to the researcher's own worldview of Postpositivism. Although the quantitative research approach was chosen, as the field of study is relative new, two initial qualitative studies were conducted prior to the quantitative researches in order to primarily identify the most prominent game elements to be studied (with higher potential to incite motivation) as well as to generate gamification designs with the identified game elements within innovative technology-based

gamification services. The utilization of a qualitative method prior to quantitative methods can also be found in multiple methods designs where researchers (mainly pragmatists) mix qualitative and quantitative methods in different stages of their studies, typically called *mixed model research*.

3.2 Research Design

Research Design is the general plan, or blueprint of activities, set and followed by the researcher that outlines how the researcher plans to satisfactorily answer the research question(s) identified (Bhattacherjee 2012; Creswell 2014) while specifying the research strategy taking under consideration issues as access of data, time, location, money and research ethics (Malhotra and Birks, 2006). As shown at the overview of the Research Design in Figure 10, the initial step is the establishment of the overall *research setting* upon which the doctoral research is based. In this step the literature review of the pertinent research is conducted as well as two cases pertaining to gamification of electronic services are presented, followed by the specification of the research questions and overall purpose as well as the research approach and research design. Once the foundations are grounded, an *exploratory research* phase is conducted in order to identify the potential of different game elements under gamification designs to facilitate motivation to engage with the gamified service. The exploratory research phase consists of a set of interviews pertaining to the game elements in order to identify the ones that pose an interest to be examined and two focus group discussions with prospective end users of the gamified services. The outcome of this process is the set of game elements and combinations of them in gamification designs as well as a design of the non-game context upon which gamification will be applied on which will be examined empirically in the next phase. The subsequent *explanatory research* phase includes two experiments in which the nature of the relationship between the causal variables and the effect to be predicted are determined

through hypotheses testing. The first empirical study has the purpose to investigate the effect of the gamification design on the facilitation of a motivational setting for engagement and participation and the second empirical study, motivated by the previous, has the purpose to investigate in-depth, the effect of gamification design on the underlying mechanisms of motivation as well as actual behaviour during participation. The following sections of chapter three present the structure and design of the doctoral research step-by-step.

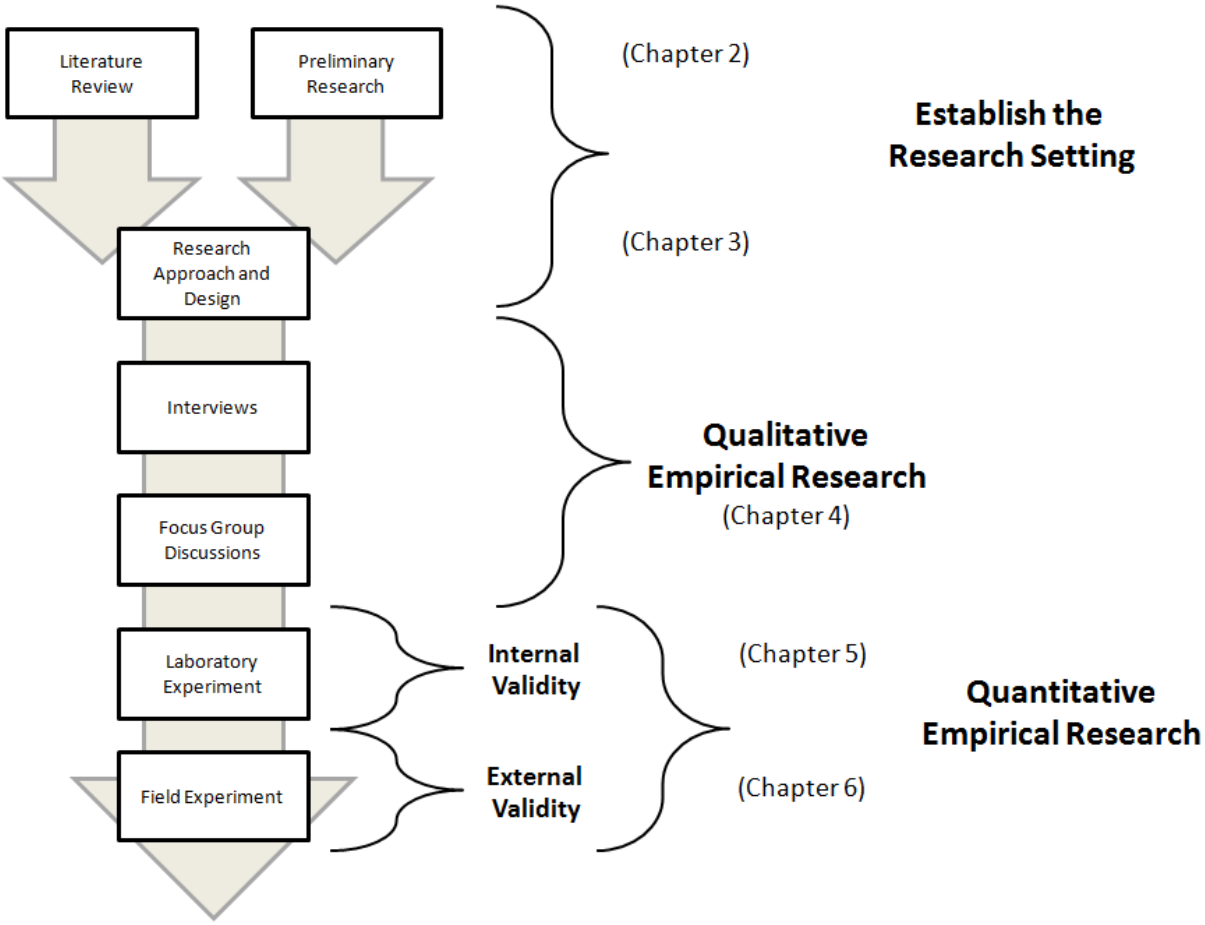


Figure 10: Overview of the Research Design

3.2.1 Identifying game elements for introduction in a gamified electronic service

In order to study the different game elements and their effect on the motivation of participants to engage with the gamified service, we had to identify those that showed potential to do so. Current literature predominately examines the game elements under a gamification design where different game elements are placed into gamification designs and in turn gamification is examined as a single system (Hamari et al., 2014; Deterding, 2015). Additionally current research effort examine individual game elements such as badges (Hamari, 2017) and Rewards (Snyder and Hartig, 2013). Therefore academic literature provides limited ideas on how combined game elements effect either the motivation of participants or their behaviour during participating in a gamified service that employs combinations of game elements under different gamification designs and the interplay of the game elements. From a plethora of available game elements (e.g. Octalysis framework holding over 70 game elements), the potential combinations is vast and in order to identify the game elements that provided either clear answers to their potential to motivate or dichotomized answers and therefore interesting to be examined, an initial qualitative phase was employed to engage with the actual potential users of the gamified system. In order to identify the game elements that showed potential to motivate and engage the end users with the gamified service, we exploited interviews that involve open-ended questions and subsequent probes as means to obtain an in-depth understanding of the participants' perceptions, feelings and opinions on the subject matter (Patton 2002) in order to develop an understanding (Kaae and Traulsen, 2015) of the potential of the game elements' potential to motivate. During the initial qualitative study that employed interviews, fifteen consumers stated their opinions, feelings, knowledge and experience on the different game elements in 45 minutes sessions. In the interviews phase, theoretical saturation was deemed achieved after the fifteenth interview

(Mason, 2010). The outcome of this study was the set of game elements to be examined for their potential to motivate for engagement and participation in a gamified service.

3.2.2 Generating gamification designs based on game elements

Building on the findings of the initial study and in order to identify the potential combinations that the game elements could have under a gamification design as well as to identify the intricacies of the non-game context, a second study was conducted. As the gamified service towards the consumers falls under new service development, in order to successfully involve the end users in the development process as small sample of innovative users (Thomke and Von Hipper, 2002) and predominately early adopters were invited in two idea generation workshops (Matthing et al 2006) in the form of focus groups, with the goal to produce the innovative gamification designs that will employee the identified game-elements over the non-game context. During a focus group, a small group of subjects (typically 6 – 10 individuals) are brought together and discuss the phenomenon of interest typically for a period of 1,5 to 2 hours under the moderation of a facilitator setting the focus group agenda and posing the initial questions (Bhattacherjee, 2012). The focus group discussions involved 16 individuals in two focus group sessions that lasted approximately 1,5 hours each and were conducted on June 14th and 15th of 2013. The design supported the elicitation of gamification designs employing the identified game elements as well as their interaction on the service's content facilitating the non-game context. As focus groups are generally suited for exploratory research (Catterall and Maclaren 2007) this study attempts to build a holistic understanding of the gamification design with respect to utilize game elements as means to facilitate motivation.

3.2.3 Investigating the effect of gamification design on intrinsic enjoyment

In the first experimental study of the explanatory phase of the doctoral research, the goal is to empirically test the initial game elements under a gamification design to support motivation for participation in the gamified service. A laboratory experiment was utilized to test the cause-effect relationship (hypothesis) in a controlled setting enabling the inferences drawn to be strong in internal validity (causality) (Bhattacherjee 2012). The laboratory experiment employs a 2 (Single Play vs. Team Collaboration) X 2 (Intrinsic Reward vs. Extrinsic Reward) between-subjects experimental design manipulated with the use of a fully functional interactive mockup of the gamified service application. The gamification design was investigated as the main antecedent of intrinsic motivation and one hundred and eighteen participants drawn from undergraduate and graduate classes at a public university were randomly assigned to one of the two game play modes and one of the two reward types. Intrinsic motivation to participate in the gamified service was measured through the self reported measure of perceived interest / enjoyment. Results were analyzed using a two-way between subjects analysis of variance (ANOVA) using SPSS 17.0 for Windows at a 95% confidence level. The outcome of this study confirms the hypothesis that the utilization of different game elements can elicit different perceived enjoyment in the gamified activity.

3.2.4 Investigating the effect of gamification design through Motivation on Behaviour

Motivated by the results of the first empirical study, the second and final experimental study of the doctoral research, the goal is to empirically test the gamification design on user behavioral outcomes (engagement with the gamified service and performance in the gamified tasks) and psychological outcomes (identify the motivational affordance of perceived

competence on the resulting behaviour in terms of user engagement and performance). A field experiment was utilized to examine the cause-effect relationship (hypothesis) in a real world setting enabling the inferences drawn to be strong in external validity (generalizability) (Bhattacherjee, 2012). The field experiment employs a 2 (Difficulty ascending vs. Difficulty descending) X 2 (Competition present vs. Competition absent) between-subjects experimental design manipulated with the use of a gamified service application. The gamification design was investigated as the main antecedent of perceived competence and user behaviour (engagement and performance). One hundred and fifty three participants drawn from undergraduate and graduate classes at a public university were randomly assigned to one of the two difficulty modes and one of the two competition modes. Intrinsic motivation to participate, Perceived competence in the activity, Autonomy felt during participation and Relatedness with other participants in the gamified service was measured through the respective constructs and measurement items of the Intrinsic Motivation Inventory of Self Determination Theory. Results were analyzed using a two-way between subjects analysis of variance (ANOVA) using SPSS 17.0 for Windows at a 95% confidence level. The outcome of this study confirms the hypothesis that the utilization of different game elements can elicit different psychological and behavioural outcomes as well as that the psychological outcome of perceived competence mediates partially the effect of the gamification design (based on selected game elements) to the behavioural outcomes of engagement and performance.

Table 1, presents an overview of the studies included in this doctoral dissertation and details about each study's methodology and research design are presented in the relevant chapters (Chapters 5 and 6).

Study	Date	Description / Character	Constructs Included	Method of Analysis
Literature review / Cases of Gamification	-	Design of two gamified electronic services in two non-game contexts	Game elements, Gamification Design, Non-game context	Qualitative Content Analysis
Interviews	4-11 May 2012	15 Interviews	Game elements	Qualitative Content Analysis
Focus Group Discussions	14-15 June 2013	2 Focus Group Discussions (N=16)	Game elements, Gamification Design, Non-game context	Qualitative Content Analysis
Laboratory Experiment	Nov 2013 - Feb 2014	Interactive mockups, N=118, 2x2 Between-subjects	Attitudes and Intentions, Intrinsic Motivation/Enjoyment, ECCB	Two-way between subjects analysis of variance
Field Experiment	Feb 2015 - Mar 2015	Gamified Smartphone application N=153 2x2 Between-subjects	ECCB, Intrinsic Motivation, Perceived Competence, Autonomy, Relatedness, Attitudes and Intentions	Two-way between subjects analysis of variance, Statistical mediation

Table 1: Overview of Studies of the doctoral research

3.3 Data Collection and Analysis

The general principles used for the data collection and the methods for analysis utilized in the studies of both the exploratory and the explanatory phases of the doctoral dissertation are presented

in this section. A detailed presentation of the data collection and results from the analyses are presented in the corresponding chapter of each study.

3.3.1 Data Collection

The initial exploratory phase of this doctoral dissertation comprises of a set of interviews and two focus groups. The participants of both studies were randomly recruited from undergraduate and post-graduate courses in a university located in the larger Athens metropolitan area in Greece. After an initial screening lead end-users were invited to participate in the interviews and the focus groups. Participation was at a voluntarily basis and no rewards were offered for their participation. The in-depth interview sessions lasted approximately forty-five minutes each and participants provided written consent to record the audio of the interviews which was in turn transcribed. In the focus group sessions, the time duration was approximately one and a half hours per session and as in the interviews, participants provided written consent to record the audio and video of the sessions and all recordings were transcribed. In the focus groups the discussions were guided by a semi-structure group interview guide and moderated by the focus group facilitator.

The first laboratory experiment in the exploratory research phase followed a factorial design with two factors for the respective game elements being Gameplay mode and Reward Type with two levels each, that is, Single Player vs. Team Collaboration for the former and Intrinsic Rewards vs. Extrinsic Rewards for the latter. In this study the gamification design was manipulated with the utilization of interactive mockups of the gamified service and each participant was randomly placed in one of the four treatments. A scenario was utilized to simulate the gamified user tasks as well as the possibilities and outcomes of the gamified activity in order to cater to the non-game context of the study (Malhotra et al.2004, Xu et al. 2009). Following the examination of the scenario, the participants experienced the interactive mockups and utilizing questionnaire instruments provided their perceptions though a set of structured questions.

The second explanatory experiment is a field experiment following a factorial design with two factors for the respective game elements being Difficulty Type and Competition with two levels each, that is, Increasing difficulty vs. Decreasing difficulty for the former and Competition present vs. Competition absent for the latter. In this study the gamification design was manipulated with the utilization of a tool developed for gamification experimentation (POOLL) and each participant, recruited from a public universities' undergraduate and post-graduate classes, was randomly placed in one of the four treatments. After the user interacted with the gamified application and was found to not have engage for a period of 5 days, an online questionnaire instrument was utilized to enable the participant to provide their perceptions though a set of structured questions and his/her in gamification behaviour was monitored by the gamification service backend.

3.3.2 Methods of Analysis

The sections below briefly outline the methods of analysis employed in the qualitative discussions and the laboratory and field experimentation phases of this doctoral dissertation.

3.3.2.1 Content Analysis

Content analysis is a research method used to analyze textual data that pays attention to the different characteristics of a language as communication with attention on either the content or the contextual meaning of a given text (Budd et al. 1967, Lindkvist, 1981, Tesch 1990). As the first phases of exploratory research included a set of in-depth interviews and two focus groups conventional content analysis was utilized to extract meaning of the outcomes of the studies being the most suitable research method (Kondracki and Wellman, 2002). Initially all recordings were transcribed and read word-by-word as a means to obtain a sense of the whole research outputs (Tesch, 1990). Subsequently codes were derived by a thorough examination of

the transcripts (Miles and Hubermann, 1994; Morgan, 1993) and the codes were sorted into the respective categories that emerged (Coffey and Atkinson,1996; Patton, 2002). Following the categorization, the definitions of the categories and subcategories pertinent to the game elements, gamification interaction and non-game context content were developed and the relationships of the game elements and gamification designs was identified and reported based on the identified antecedents and expected consequences (Morse and Field, 1995).

3.3.2.2 Factorial analysis of variance (ANOVA)

As the gamification design includes the parallel examination of two game elements under a gamification design, in the laboratory experiment and in the field experiment the data analysis is based on a factorial analysis of variance (ANOVA). As the research design involves a two-by-two factorial design, a two-way analysis of variance (ANOVA) is the selected inferential test given that it is well suited to this investigation that involves a "complex real-world problem with practical application (MacFarland, 2012). Therefore a factorial ANOVA is used in order to test the effects of two (or more) independent variables, that is in our case the gameplay mode and reward type for the laboratory experiment and the Difficulty and Competition for the field experiment on the same dependent variable (Intrinsic motivation for the laboratory experiment and Perceived competence, Engagement and Performance for the field experiment) as main effect. Additionally it examines how the independent variables influence each other on the dependent variable at hand which is the interaction effects (Martin and Bridgmon, 2012).

The generalized linear model for the two-way factorial design of this doctoral research is designed as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1 x_2 + \varepsilon$$

where y represents the dependent variable and x_1 and x_2 are the factors representing the two categories in the factorial design. The regression coefficients β_1 and β_2 provide the effect size estimates for the main effects independently and β_3 for the interaction effect (Bhattacherjee, 2012). A factorial ANOVA has three underlying assumptions that need to be met in order to be used, namely Normality, Homogeneity of variance and Independence of observations. Normality is met when the scores of the dependent variable per condition follow the normal distribution around the mean, Homogeneity of variance is met when the variances of the scores of the dependent variable is constant and Independence of observations is met when the observations are independent and not correlated with each other (Bhattacherjee, 2012).

3.3.2.3 Statistical Mediation Analysis

As the purpose of this doctoral research is the examination of the effect of different gamification designs based on game elements introduced on participant behaviour, the underlying motivations that support that effect are also examined. Mediation analysis is the process of examining if variables (called mediators) act as intermediate variables between the influence of independent variables to dependent variables. The role of the mediating relationship is the understanding of "how effects occur in the first place" (Hayes, 2013) leading to gaining insight about the underlying mechanism and the etiology of the effect. In the case of an independent variable (X) and a dependent variable (Y), mediation builds upon the basic linear regression model by adding a third variable (M) where the third variable is thought to come in between X and Y leading to X leading to mediating variable (M) and in turn leading to (Y) as illustrated in Figure 10.

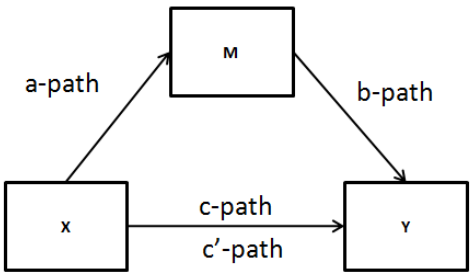


Figure 10: Basic Mediation Model (Preacher and Hayes, 2008)

In mediation the c-path denoting the direct effect is expected to be smaller with the addition of the mediator and the difference of the c-path to the c´-path should be statistically significant. Thus if the a*b being the indirect effect is statistically significant, mediation has occurred (Preacher and Hayes, 2008). In order to examine for mediation effects, the bootstrapping analysis is utilized as it is a non-parametric test that does not violate assumptions of normality and is utilized in studies with small sample sizes (Preacher and Hayes, 2008; Good, 2001; Lunneborg, 2000; Wood 2005). In bootstrapping, the sample of the study is treated as a miniature representation of the whole population and different observations in that sample are "resampled" with replacement and statistics are in turn calculated for the newly constructed sample. This process when conducted in the order of thousands empirically constructs a representation of the sampling distribution that is in turn used for the inferential task (Hayes, 2013). The confidence intervals produced with the bootstrapping method yield inferences that are more likely to be accurate as they better respect the irregularity of the sampling distribution in order to confidently conclude the existence of a significant mediation effect (Zhao, Lynch and Chen 2010).

3.4 The choice of the non-game context

Gamification has been utilized in a plethora of non game contexts such as Health (Hamari and Koivisto,2013; Hori et al.,2013), Education (Cheong et al.,2013; Dong et al.,2012; Fitz-Walter et al.,2011; Li et al., 2012), Commerce and Marketing (Hamari and Jarvinen,2011; Hamari,2013). The application context of the study and the non-game context selected for examining the above hypotheses is the consumer shopping process in the fast moving consumer goods sector and in particular ecologically conscious consumption behaviour and raising awareness on environmental issues related to product use and consumption. Previous efforts in raising awareness on environmental issues and environmental consumption utilizing gamification, can be found predominately on the environmentally conscious recourses consumption such as energy and water (Kuntz et al. 2012; Gustafsson et al., 2009; Geelen, Keyson, Boess and Brezet, 2012; Gamberini et al., 2011), however the FMCG sector is a prominent field as in the shopping process, intrinsically oriented motives, as altruism and desire to protect the environment towards common good, collide with extrinsically oriented monetary incentives. Having focused on the consumer and the potential shift towards sustainable consumption practices and raising awareness on environmental issues via the employment of gamification, we proceed to examine the attributes that formulate the profile and behavioral patterns of the Green consumer. These attributes have been studied extensively in the literature both from the individual consumer perspective (Straughan & Roberts, 1999; Roberts ,1996) as well as at an aggregate national level (Dunlap, Mertig, & E., 2000). Pertaining to the individual consumer perspective research in different industry sectors reveals that although environmental factors are considered at the point of purchase, they are not the sole or most important factors affecting consumer choice (Gaspar & Antunes, 2011; Gadenne et al., 2011; Faiers, Cook, &

Neame, 2007). However, Straughan & Roberts (1999) identified that the green consumer behavior is driven by the person's "…belief that individuals can play an important role in combating environmental destruction…", that is consistent with the findings of the stream of research that explores the psychological benefits that arise from the person's contribution to the ecological common good (Wiser, 1998; Hartmann & Apaolaza- Ibáñez, 2012). The aforementioned stream of researchers portrays a consumer driven by internal motives on their choices where as the current practice in the FMCG sector is focused on incentivising the consumer with external redeemable rewards via loyalty programs.

Chapter 4: Identifying potential for motivation in game-elements and gamification design

Having reviewed the pertinent literature and being motivated by the need to examine the different game elements stemming from the cases, research was conducted to identify the most prominent game elements and potential intricacies of the different game elements in terms of ability to motivate for engagement and performance in the gamified electronic service. Additionally as different combinations of game elements have been found to have different potential impact on the participants, an exploratory phase would account for the most prominent setup of gamification design to be considered as eligible to motivate participation and engagement.

In order to gain valuable insights on the different game elements and their potential to drive motivation to participate in and engage with a gamified service, a series of in-depth interviews and two focus groups were conducted with potential users of the gamified service. The aim of the in-depth interviews was two-fold:

1. To examine the potential (if any) intricacies of the non-game context as means to inform the gamified system design and
2. To identify and drill down on different game elements and their potential implementation in a gamified system in terms of engagement potential.

The aim of the focus groups was to identify different potential designs of the gamified services and combinations of game elements with the potential to motivate participation and engagement, through gamification and inform the design of the gamified system.

4.1 Interviews

In order to gain insights into users' reactions to the introduction of gamification in the non-game context of the environmental awareness and shopping process in the FMCG sector, interviews with fifteen consumers were conducted (8 female). The interviews took place between May 4th - 11th 2012 and lasted approximately 45 minutes per interview. As the focus of the interviews was to examine the game elements and their potential to be introduced in the gamified service the interview questions were grounded on three pillars, each addressing a different part of the gamification design process. The first pillar utilized questions aimed to identify participants' game play preferences and habits and their perceptions towards playing games. The second pillar consisted of questions related to the non-game context at hand and their perceptions on environmentally aware consumption, shopping behaviour and patterns as well as their degree of environmental awareness. Lastly the third pillar utilized questions pertaining to the potential of different games (and game elements) to be introduced in the non-game context as means to create a new gamified system that would motivate them to engage.

The sample of consumers and potential participants of the gamified service, consisted of randomly selected individuals from a public universities under and post graduate classes, screened through the Matthing, Kristensson, Gustafsson, & Parasuraman's (2006) typology of consumers. As gamification is a relatively new concept and not yet diffused, the aforementioned selection process was conducted to secure that the consumers selected to participate exhibited characteristics that enable them to be open to new and innovative solutions. In this typology, authors divide consumers in six main categories: leaders-explorers, pioneers, skeptics, paranoids and laggards, based on the characteristic of how innovative a person is. Utilizing the aforementioned typology from a starting pool of thirty one (31) randomly recruited individuals

that were invited to fill offline and/or online questionnaires, twenty (20) individuals who were found to belong in the categories of leaders-explorers, pioneers and skeptics were invited for participation. Out of the invited participants, fifteen (15) responded positively and were included in the study.

Prior to the interviews and in order to determine the degree of ecological worldview and ecological conscious consumer behavior of the participants and further segment them, two additional offline questionnaires were administered. The first was the New Environmental Paradigm – NEP (Dunlap, Van Liere, Mertig, & Jones, 2000) and the second was the Ecological Conscious Consumer Behavior (Roberts, 1996). The latter in particular was utilized to measure the extent to which the respondents purchase goods / services that they believe have a "more positive" impact on the environment in relation to their counterpart alternatives. The resulting sample (Figure 11) of lead consumers consisted of both male (7) and female (8) consumers. The age range of the sample was segmented into [18-24 – 5 Participants, 25-29 – 6 Participants and 30-45 – 4 Participants] and the sample equally consisted of participants with both High environment-conscious behavior (8 Participants) and Low environment-conscious behavior (7 Participants) enabling the representation of all levels of the green consumer.

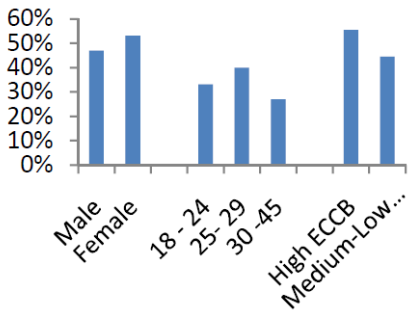


Figure 11: Demographics of lead consumer sample

Although the number of the consumer sample consisted of fifteen consumers, with careful sampling and thorough collection technique, a small amount of in-depth interviews can result with data capable of addressing the research question (Holloway, 1997). The interviews were continued until there was no production of any new information or insights, following the theoretical saturation general rule of qualitative research. In the present study theoretical saturation was deemed to be achieved and satisfactory for valid sampling after fifteen consumers. The present study is consistent with the suggested valid range of case sampling of more than ten cases (Eisenhardt, 1989). The information gathered during the interviews was content analyzed and coded by two independent coders into categories pertaining to the present research.

A number of categories were decided upon ahead of time (e.g. Game Mechanics for incorporation, Shopping process) while other categories were identified based on the lead consumer responses (e.g. Flow of gamified service). In the case of disagreement on the classification of any particular statement, the disagreements were resolved upon joint discussion. The resulting categories are presented in Table 2 as follows

High Level In-Depth Interview Categories	**Sub-Categories**
Non-Game Context	Current Environmental Conscious Consuming Behaviours, State of Enviornmanetal worldviews
Gameplay Habits (Accounting for Aesthetics of MDA framework)	Game play motives, Game play frequency, Game play medium
Gameplay Preferences (Accounting for Dynamics of	Game play mode (Competitive, Collaborative, Single player)

MDA framework)	
Game Elements (Accounting for Mechanics of MDA framework)	Points, Badges, Leaderboard, Rewards

Table 2: Predefined In-Depth Interviews Categories

In the process of the in-depth interviews, consumers expressed their opinion and stated their terms and subsequent degrees of potential engagement and expected benefits from participation in a gamified system for the specific non-game context of energy awareness and environmentally conscious consumption behaviour. The results of the interviews are presented in the following paragraphs.

4.1.1 Non-Game Context

In relation to the non-game context of environmental awareness and environmentally conscious consumption behaviour the consumers identified a number of interesting findings that can be utilized in the design phase of the gamified electronic service.

Initially the overall non-game context was found to have potential to be infused with game elements and transformed into a game-like activity (12 Individuals). In order for the part of the non-game context pertinent to raising environmental awareness to be met, participants opted for general information and pieces of environmental knowledge to be introduced in the overall application as means to enable learning. For the part of the non-game context pertinent to motivating the consumers to behave in an ecologically conscious manner in the shopping context, a connection to the actual shopping process was deemed important in terms of game

mechanics. A direct link between the shopping choices and the game mechanics should exist. The following statement illustrates the proposal:

"When you shop in an ecological (or not) way something is triggered and something happens".

This direct link from shopping behavior to a game-like experience (or actual game) could be established (as described by the majority of the consumers) by the introduction of a mechanism *"loosely related to the loyalty scheme that already exists".* At present, when consumers shop in a specific manner, they receive loyalty points that they later on redeem for various commodities or price reduction.

In relation to the content complementing the non-game context and the goals of the gamification consumers classified in the high and low environmentally conscious consumer behaviour opted for different content as means of supporting them in the process. In particular consumers displaying a high environmentally conscious consumption behaviour stated that they would prefer to receive information relevant to the degree of "eco-friendliness" of the product in the form of text or label in order to factor the information into their selection decision (e.g. CO_2, energy efficiency in production, recycling information etc.) . On the other hand, consumers who display a low environmentally conscious consumption behaviour opted for the introduction of general information on the non-game context as they were less inclined to product specific eco-information.

Overall the majority of the participants described a gamified system that would be build around two main pillars: (a) The product specific characteristics that would account for the content of the service to support the non-game context's goals and (b) An awarding program service that would extend the loyalty programs.

Overall Environmental Information: The participants proposed a service where the user could receive information pertaining to the environment and learn about current issues and possible solutions as means to learn and raise their awareness on environmental issues.

Product Specific Characteristics: The consumers requested a service that would inform them on the sustainability and eco-friendliness of the product. The service should provide information related to the production and/or distribution process followed for the product, its certifications, eco-comparative product information etc.

Awarding program service: The proposed service would include a "loyalty program" type of service where ecologically conscious consumer behavior would be awarded. The consumers described a mechanism where the consumer collects points when one purchases eco-friendly products and later on he/she can exchange the received points for price reduction or free products or the acknowledgment of doing something good for the environment.

4.1.2 Game Elements under a Gamification Design

In addition to the valuable insights pertaining to the eligibility and potential of the non-game context to be transformed in a game-like experience, the in-depth interviews resulted in a number of insights pertaining to the game elements and gamification setup that would support the process.

4.1.2.1 Game element: Point

In regards to the game element of point, 14 consumers stated the point should be positive and based upon the actions of the users in parallel to the goal of the gamification. In addition the overall point awarding mechanism should reflect the ongoing behaviour of the participant in the

system and when the participants complete an action dictated by the system a point (or set of points) could be awarded to show success. The points could be in two forms (a) Experience points – XP as positive and cumulative points that showcase progress and (b) Redeemable points –RP that are earn and burn points that can be won for in – gamification actions and redeemed for rewards outside the gamified service. The aforementioned sub-types of points could account for the different goals the consumers identified and in particular, experience points could be utilized in the environmental awareness service where as participants raise their awareness and/or knowledge they are awarded experience points and redeemable points could be utilized to account for the "loyalty – like" part of the gamified service where participants that purchase environmentally friendly products are awarded redeemable points to later redeem for a potential discount.

4.1.2.2 Gameplay Mode

Extending the point-awarding system and transferring it into a possible game (or game-like experience), consumers identified the key characteristic of gameplay mode stemming from the way the participants complete the in-gamification goals. Operating under the assumption that shopping in an ecologically conscious way or raising ones awareness leads to the accumulation of points, consumers stated their interest in the ability to try to complete the goals either on their own (9 participants) or in collaboration with others (6 Participants). This leads to the ability of the designed gamification design to support both single player and team player mode. In single player mode each participant would pursue the goals of the gamified systems on his/her own and in team player mode each participant would pursue the goals of the gamified system in collaboration with other players.

4.1.2.3 Gameplay mode: Competition and Game Element: Leaderboard

In extension to the gameplay mode, the consumers the consumers identified the inherent comparison that stems in participating in such a gamified activity. As the use of points (and accumulation of them) in single or team gameplay modes leads to a player (or a group of players) having more/less points than others participants identified that it is a competitive setting. However the sample of participants was dichotomized between those that were in favor of competition (8 participants), interested in seeing their relative stance in the gamified process and those against it (7 participants) who did not want to know where they stand relative to other participants. Participants that were in favor of seeing their relative position to others and those that were against it, identified a different number of potential levels of comparison. In particular the identified levels of comparison as optimal for engagement efficiency included: (a) Friends, (b) Non-Friends, (c) Location specific (d) in service specific. In the context of comparison with their close friends in the form of ranking, 8 participants of the sample stated that they would like to know their own environmental consumption practices and environmental awareness (past, current and evolution of) as individuals as well as where they rank amongst their friends. As the comparison expanded to include non-friends, the percentage of consumer's interest to receive comparative results dropped to 5 participants. A further extension to the degree of location (e.g. city/country) improved the interest to receive comparative results to 6 participants. From then on, comparison on the level of continent as individuals was described as out of context and the participation intent was reduced. Upon concluding the comparison levels, the majority of the participants stated that besides individual comparison they expressed their interest in a collaborative approach to the comparison.

Pertaining to stated intent of participation, the prevailing community formation design for comparison and ranking (based on ecological consumption and behavior) were identified as the Location Community and Virtual Community. (a) Location community: The respondents expressed increased interest in formation of the City/Country Community for degree of community comparison especially when the incentives for participation spanned from the virtual world to the real world and were of environmental nature. (b) Virtual Community: Besides physical communities, consumers displayed interest in the possibility to create custom and virtual communities and participate in the gamified service.

In regards to the existence of competition and the ability to display it, participates indicated that it could be in the form of a sorted list based on the points each participant (and/or team) had accumulated. Additionally and to cater for the different levels of comparison identified, the list could present different information upon user input (e.g. a list for friends, a list for country, a list for participants in the overall service). The representation of the ranking in the form of a list led to the insight of the potential introduction of the game element of a leaderboard as means to enable comparison and the results of the competition.

4.1.2.4 Game element: Rewards (Monetary and Badges)

Another set of important outcomes of the interviews pertain to the rewarding mechanisms introduced as outcome of the gamification when users achieved the set goals of the gamification service. During the interviews, various reward mechanisms and rewards were proposed with the most prominent being: (a) Monetary rewards targeted towards the consumer that successfully completed a gamification goal or targeted towards an external and general entity like the environment: After the accumulation of a defined amount of points (absolute or relative to the time or effort given, the consumer would be awarded with a reward of price reduction on

upcoming ecological friendly (or not) products purchase of their choice. The monetary reward was found applicable to individual rewarding and was supported by 8 consumers. Consumers additionally stated a different type of monetary reward where the reward would be in the form of "Doing something for the environment". In this case, consumers stated that they would participate in the gamified service if the defined prize addressed an environmental issue or supported a cause, applicable to collaborative mode of play and supported by 7 consumers. (b) Virtual rewards: The reward mechanism was described as extendable / transferable to the virtual / online / game world. This type of rewards would include (but not limited to) the awarding of personal and collaborative badges (eco stars, trees, virtual forests etc.) as defined by the respective rules of the gamified application. The respondents indicated that although monetary rewards are important, virtual rewards are sought out particularly for continuous engagement with the process in its entirety as supported by 12 consumers.

Lastly a major outcome of the interviews pertains to the difficulty in obtaining the identified rewards. In particular, the sample of participants was separated between the ones that opted for the rewards to become progressively difficult to obtain (8 Participants) and the ones that suggested that rewards should be easy to obtain (7 Participants) so as not to be bored and always win something. The present finding led to a differentiation from the typical gamification reward structures (and level structures) that stem from the game design literature. Typically in gamification as the player becomes acquainted with the overall process the difficulty upon which the rewards are received was progressively upwards in order to match the evolving skill of the player in the non-game context (Barata et al., 2013). However as the games and gamification evolved, research has shown that difficulty in obtaining the rewards (or completing levels)

optimally should be adapted to individual players' abilities (Nagle, Wolf and Riener, 2016; Jacobs et al. 2013)

The purpose of the interviews was to explore the potential of the non-game context to become gamified by the introduction of playful affordances in order for the participants to engage with resulting gamified service. A series of preliminary findings that inform the design and development of the gamified services are illustrated as follows:

The non-game context can be supported via the introduced content in terms of an environmental awareness service that will motivate the users to learn about the general environmental related information and a separate service that will inform the participants on the impact of different products on the environment and their degree of environmental friendliness.

In terms of game elements the base game element of point was identified as a first feedback mechanism on successful in-gamification progression based on the tasks proposed by the system and different rewards could be introduced both monetary and virtual upon successful completion of a set of actions/tasks. The tasks and actions required could be of different degrees of difficulty and linked with the rewards obtained. Lastly pertaining to the mode of play different setups could be employed like single player mode and team based mode and in both types the game element of a leaderboard could signify the relative position of each member (or team) in the global gamified service.

In order to identify specific operationalizations of the game mechanics and dynamics, a set of focus groups were utilized to inform the design of the gamified system as presented in the following section.

4.2 Focus Groups

In parallel to the gamified service development and in building on the findings of the interviews, and in order to better understand the potential of different game elements formed in a gamification architecture to motivate users to engage with the gamified service two focus groups were conducted. The goal of the focus groups was two-fold: To first identify the gamified services to support environmental awareness (pertinent to the non-game context) and secondly to formulate potential gamification designs utilizing the most prominent game elements. In order to select the participants of the focus groups the Matthing et al. (2006) methodology was utilized that enabled us to categorize with the use of an on-line questionnaire potential participants into five categories namely: *leaders-explorers*, *pioneers*, *skeptics, paranoids* and *laggards*. According to the authors, participants that belong in the first three types are considered ideal for participation in a focus group. Additional to the previous screening a second screening was conducted to account for the ability to include participants with varying degrees of ecologically conscious consumer behaviour in the focus groups. Out of the 25 collected questionnaires, 16 individuals were invited to participate in the focus groups, separated into two (2) focus groups (Each focus group having equally distributed leaders, pioneers and skeptics). The focus groups took place between June 14th and 15th 2013 and the participants' gender of the participants is illustrated in Figure 12. Each focus group involved 8 participants and lasted for 1 hour approximately. All participants upon entering provided written consent to record the audio of the discussion and both recordings of the focus groups were transcribed and analyzed.

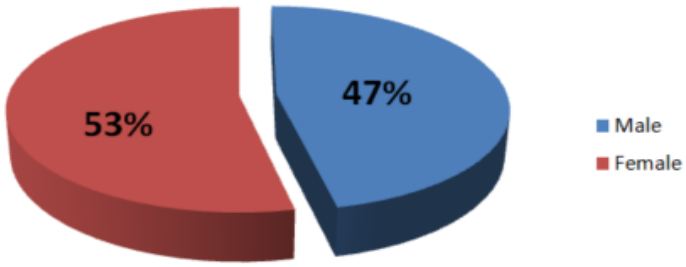


Figure 12: Percentage of the focus groups participants per sex

The pillars of the discussion during the focus group derive from the findings of the in-depth interviews and are presented in Table 3 as follows:

Main Pillars	Sub Topics
Gamified Service Medium	Web application, Smartphone application, Offline version
Theme / Genre Type	Different types of game genres
Non-game context	Content
Game Elements (Mechanics of MDA Framework)	Points, Badges, Leaderboard, Status, Levels, Rewards
Mode of Play (Dynamics of MDA Framework)	Single Play, Team Play, Competition, Collaboration
Game Rules (Dynamics of MDA Framework)	Points Awarding, Level Structure, Win-Loss Conditions

Table 3: Focus Group Discussion Pillars

In relation to the gamified service medium that will enable the consumers to interact with the electronic service, the participants indicated that the preferable way would be through a smartphone application. The resonance behind that was that the gamified service should enable the users to participate at a time and place of their choosing and not be limited to their home/or office. As the non-game context also includes the ability of the consumers to state their perceptions of product-greenness of different products, the participants opted to be able to do it also at the point of purchase (e.g. a supermarket or a convenience store).

Pertaining to the overall theme of the gamified services to support environmental awareness, the consumers highlighted that the process and content should revolve around information relevant to the non-game context (e.g. Questions on environmental issues). The overall theme of the gamified service was identified to be in the form of a quiz based game in order to enable the users to answer questions relevant to different environmental issues as well as enabling them to learn more about the environmental impact of different products. As stated by a female user in her 20s,

" I would like to receive points while learning by reading about environmental information and answering questions".

A consensus on both focus groups was formulated based on the aforementioned overall approach for a main theme in the gamified service, validating the findings of the interviews on the specific matter. As the theme was identified to be in the genre of quiz-based games, related to the content catering the non-game context, a two fold proposal was formulated. Initially, the gamified app should include information on various environmental issues upon which the users could answer questions. This would enable the users to learn a variety of information of environmental nature. Secondly the gamified application should include information on different

products that the users could see / read and then in turn provide their perceptions on product greenness of different products.

With respect to the game elements eligible for introduction in the gamified service, pertaining to the Points participants stated that they should be positive and gained (in line with the interview's outcomes). The points could serve as means to show the participants that they completed successfully the tasks (or small portions of a task) of the application. Additionally the points could in turn used to show both in team- and single- play modes where each team (or individual) stands if they are tallied and sorted. The sorting will create the leaderboard of teams or individuals. Furthermore badges could be used to signify important milestones within the application that an individual (or team) has achieved. An interesting outcome pertains to the rewards that the users will receive for successful completion of the tasks of the application. In this case the participants opted for different types of rewards as means to motivate participation in the gamified application. The rewards that were sought after were both of physical nature (e.g. Money, discounts, coupons) as well as virtual (e.g. A badge of succeeding). This dichotomy was evident in the analysis of the results were it was identified that individuals who were highly environmentally conscious in their consumption behaviour opted for virtual rewards whereas individuals that were lower in their environmentally conscious consumption behaviour opted for physical rewards. Lastly and in relation to Levels the participants mutually agreed that different levels should exist in the gamified application that would enable them to progress gradually.

With respect to the game play type the users were separated to those who opted for single player mode of play and those who found playing in teams to be perceived as more engaging and motivating. The participants that opted for single player mode (and each player going after the goal of the gamified app) stated that the specific non-game context pertains to individual choices

and therefore it would be a matter of each individual to learn to be more environmentally conscious in their everyday life. In the words of a male participant, 25 years old,

"I would like to know what recycling of a bottle means, what it saves and if I recycle I would like to get some sort of reward for that".

On the other hand the ones opted for a team-based gameplay stated that although the environmental awareness adheres to individuals the result of being more environmental friendly and the possible rewards that would come along in the gamified system should account towards not themselves but be broader and address the community as a whole. In particular the following statements illustrate the positioning towards a collaborative gameplay and reward structure:

"I would like to have a process of collaborative education and collaborative potential savings from what all learned." Male, 22 years old and

"If I am to win with my team I would like the prize to be given το all or to be used to do something for the environment". Female, 26 years old.

Additionally, in terms of the team formation and the way the teams played the stated preference was for the gamified service to be able to offer the ability for teams to be formed based on different modes (e.g. location of neighborhood, country etc.) and individual participants belonging in teams to collaboratively go after the goals and rewards against other teams.

Lastly in relation to the gameplay rules that will govern the gameplay, participants stated that the tasks should be easy and the participants should be given clear instructions on pre-defined goals. Additionally, they indicated that the users should be rewarded for interacting with the service in a continuous manner and based on their respective contributions.

4.3 Synopsis of the In-Depth Interviews and Focus Group Results

The aim of the preliminary studies was to explore the potential of the non-game context at hand to be enhanced with playful affordances in order to motivate potential participants to engage with the produced gamified service. In order to examine the non-game context and the potential of game elements to support it, a series of interviews were initially performed to harness the perceptions of end-users relative to different game-elements stemming from the gamification literature and the overall non-game context. The interviews provided important insights that were later utilized in two focus groups that were utilized to identify the most prominent gamification architectures' operationalizations (utilizing different game elements) as means to inform the design of the gamified services. A synopsis of the key findings of both the interviews and the focus groups is presented in Table 4 as follows:

Gamification Design	Results
Gamified Service Medium	The gamified service should be served via a smartphone application
Theme / Genre Type	The gamified service should resemble a Quiz Type game, offering the ability to (a) Provide information on environmental issues, (b) Provide information on product environmental friendliness, (c) Provide Questions and answers.
Non-game context	The non-game context was found eligible to be enhanced with gameful affordances and become gamified. Additionally the non-game context should be reflected in the content of the smartphone application.

Game Elements (Mechanics of the MDA Framework)	The gamified service should employ a number of game elements: *Points* could account for successful progression and be of different type (e.g. Experience Points, Redeemable Points). *Badges* could account for virtual rewards based on successful completion of tasks. *Monetary rewards* could account for physical rewards based on successful completion of tasks. A *Leaderboard* could be utilized as a comparison medium in single player and in team player signifying competition , *Levels* should be used as a bundle of tasks that have different difficulty to be completed (Easy and Difficult)
Mode of Play (Dynamics of the MDA Framework)	The gamified service should enable (and be experienced in) Single Play mode where individuals complete tasks and receive rewards on their own and, *Team Play* where individuals complete tasks and receive rewards as teams.

Table 4: Synopsis of findings

During the interviews and focus groups in the majority of the gamification related issues, pertaining to the design of the gamified service there was a consensus in the operationalization of the different game elements. However there were specific cases (in the gameplay and separate game elements) where the participants opted for contradicting results leading to the need for further research. In particular the main gameplay types and game elements that presented dichotomization in the responses and perceptions of what would motivate users for engagement with the gamified service are presented in the following:

Game Play Mode: The way the gamified service is experienced could be both (or either) in single player mode and in team player mode towards successfully completing the tasks.

Rewards: Rewards upon successful completion of tasks could be both (or either) of physical nature (e.g. Money) or virtual nature (e.g. Badge)

Competition: The existence (or absence) of competition could motivate participants to engage with the gamified service.

Levels: The different levels should be easy (or difficult) to be completed as means to motivate participants to progress through the bundles of tasks.

The aforementioned differentiation identified in the perceptions of the participants in the interviews and focus groups set the basis for further needed research as presented in the following chapters, towards the design and development of the gamified electronic service.

Chapter 5: Assessing the impact of gamification design on intrinsic enjoyment

5.1 Hypothesis Development

The preliminary studies pertaining to the selection of game elements eligible to be introduced in a gamification design to motivate participants to engage with the non-game context, yielded a number of interesting findings. Primarily, the finding relative to the way the goal of the gamified activity is pursued (As an individual or As a team) was found to not have a unanimous answer and secondary the reward upon successful completion of the activity also presented dichotomized results (Physical or Virtual reward). Building on the aforementioned outcomes of the semi-structured interviews, and pertaining to the initial set of identified game elements in parallel to the type of motivation shout for to support user engagement with the gamified task, a laboratory experiment was utilized. The aim of the laboratory experiment was to examine for the potential of the gamification design to engage participants in a playful manner, whilst taking under consideration the two different results on the two different game elements.

5.1.1 Gamification Rewards and Enjoyment

In gamification the typical engagement circle is based upon a continuum of Task/Challenge – User Performance – Reward – Motivation to complete task (Darejeh and Salim, 2016) as illustrated in Figure 13, and rewards play a fundamental role in maintaining this engagement loop. In the pertinent literature a number of different reward possibilities are reported and initial attempts to classify the rewards are conducted, as means to inform the

gamification process of a service on the subject matter of gamification rewards. Within a reward structure, example rewards include:

- *Financial Rewards:* The user is rewarded with money upon successful completion of task(s)
- *Goods / Prizes:* The user is rewarded with prize(s) (e.g. a Smartphone) upon successful completion of task(s)
- *Penalties:* The user loses earned in-game rewards (e.g. Points) upon failure to complete task(s) – This is considered a negative reward
- *Progress Bar:* The user is rewarded with knowing that (s)he is progressing in the task(s) upon successful completion of task(s)
- *Social Reward / Recognition:* The user receives public (or in-game) recognition of his/her achievement upon successful completion of task(s)
- *Personal Achievement:* The user receives private in-game recognition of his/her achievement upon successful completion of task(s)

In order to identify the different types of rewards in terms of type of motivation they can support we can utilize Self Determination Theory and in particular Goal Contents Theory (GCT) (Vansteenkiste et al. 2006) a sub-theory of Self Determination Theory (SDT), where there is a separation of individuals being motivated to pursue an intrinsic goal leading to an intrinsic reward opposed to an extrinsic goal leading to an extrinsic reward. In gamification, different rewards can be classified into the different ends of the spectrum between Intrinsic Rewards and Extrinsic Rewards (Dale, 2014) as illustrated in Figure 14. Based on the findings of our qualitative studies monetary oriented rewards (as a Physical Reward) in a gamification setting can be classified as extrinsic rewards leading to extrinsic motivation, whereas the identification

of an achievement to succeed (as a Virtual Reward) can be classified as an intrinsic reward leading to intrinsic motivation.

Figure 13: Gamification Process (Darejeh and Salim, 2016)

Extrinsic	Intrinsic
Money	Recognition
Points/Badges/Trophies	Personal Achievement
Prizes	Responsibility
Penalties	Power
Quests	Fun
Progress bars	Mastery

Figure 14: Intrinsic and Extrinsic Rewards in gamification (Dale, 2014)

In the literature both extrinsic and intrinsic rewards, have been utilized in gamified systems and games to motivate users to adhere to the gamified process and engage with the service. An example of extrinsic rewards application is in “Energy Battle” (Geelen et al. 2012) a gamified service to promote the reduction of household energy consumption and achievement of savings, were the the game element of prize rewards were identified to be the most motivating game element for energy saving. Another example of extrinsic rewards is found in “Do it in the dark” (Senbel et al. 2014) an entertainment competition to increase student interactions and participation in energy conservation campaigns where the game-element of prize rewards was found to be the most motivating game element. On the opposite end, that of intrinsic rewards, acknowledgement of achievements in the task of the gamified services have also been found to positively impact engagement. For example in PeerWise (Deny, 2013) the acknowledgement of personal achievements in an online learning tool (signified by a virtual badge) led to a significant

positive effect on the number of questions answered by the participating students. Another example in the education domain showed that achievements as a reward can be used to affect the in-game behaviour and engagement of students (Hakulinen et al. 2013). Overall intrinsic rewards in a gamification setting can motivate the end users to participate in the process for greater self-fulfillment whereas extrinsic rewards can motivate end users to participate in the process as means to earn something.

Although both intrinsic and extrinsic rewards have been found to motivate end users to engage and perform, previous research indicates that extrinsic reward motivation can undermine intrinsic motivation, as when individuals perform an activity driven by an external (and separable to one-self) reward they start to see the cause in that behaviour to that reward opposed to their interest or enjoyment (DeCharms 1968), with negative consequences at least to the satisfaction deriving from the activity (Geen et al. 1984). However gamification should maintain (or not remove) the interest or enjoyment of participants. Therefore, based on the aforementioned literature, as gamification is proposed as means to transfer the benefits of games to non-game contexts and their participants, it is evident that a subsequent aim of gamification is to increase the enjoyment and overall intrinsic motivation (as Interest/Enjoyment are the self reported measure of Intrinsic Motivation according to SDT) to participate. On that account, we propose:

Hypothesis 1: Intrinsic oriented rewards will lead to higher enjoyment during participation than extrinsic.

5.1.2 Gameplay Mode and Enjoyment

Pertaining to the findings relevant to the game play mode the interviews and focus groups conducted, resulted in a dichotomy between the ones that opted for Single Player mode of the gamified service and the ones that opted for the ability to collaborate with others towards achieving the goals and obtaining the rewards. As gamification identifies its origins from the game design literature it was expected that the ability of forming teams as means to achieve a goal would be an expected proposed result at least from the participants that were familiar with some sort of game in their life. Team formation in particular is considered one of the ten ingredients to create a successful game design among Self representation, Narrative, Feedback, 3D environments, Levels, Economies, Competition, Rank and Time-pressure (Reevs and Red 2009). Going from the game design literature to online games, the ability to form teams as means to pursue a common goal is predominately present on Massively Multiplayer Online Games (MMOGs) (Kong et al. 2012). In the MMOG game genre, players are encouraged to collaborate with other players by creating teams, groups and guilds towards the completion of a common activity and the achievement of a common goal in collaborative form. The aforementioned player collaboration and the exhibited social factor is one of the "main reasons behind the attraction to MMORPGs" (Ducheneaut et. al 2006 p.7) and a motivating factor to engage with the MMOGs. Extending on the benefits of team formation and collaboration as exhibited in the MMOG genre, "MMOG players are motivated to learn to perform well individually in order to achieve a collaborative victory" (Kong et al. 2012 p.7). The aforementioned collaborative nature and its exhibited players' benefits in the online games literature as means to promote Intrinsic Motivation to participate, is also consistent with the research of Ryan et al. (2006). As in Self Determination Theory, one of the three important facilitators of intrinsic motivation is

Relatedness (with Autonomy and Competence being the remaining two), in a team collaborative setting, individuals should be enabled to experience it, referring to a sense of connection to other people via the game itself. That connection as experienced by the individual's contribution to a collaborative effort towards a goal can be seminal to the impact of a gamified service on individual's engagement with the service and experienced fun during participation and should be considered for introduction in a gamified service. On that account we propose:

Hypothesis 2: Team based collaboration towards rewards will lead to higher enjoyment during participation than Single play.

5.2 Method

In order to test the specific hypotheses and examine the potential benefits of introducing intrinsic and extrinsic reward settings, as defined by respective game element, as well as Single play and Team community collaboration, a two (Reward type) by two (Game Play mode) experimental design was utilized through an interactive mockup of a mobile application, in a laboratory experiment. The gamified service consisted of four interactive mockups of the mobile application, varying only in the selected game elements, as presented in the following paragraphs.

5.2.2. Experimental Design and Setting

In order to design the interactive mockups of the application of the gamified electronic service and based on the results of the qualitative research that indicated the non-game context to be reflected in the content, the overall narrative was developed. The narrative placed the user at

the point of product selection in front of the shelf of a supermarket whilst (s)he was considering the purchase of an environmentally friendly product. As means to enable autonomy the user was able to virtually interrogate the exhibited products should (s)he opts to and was subsequently presented with environmental information associated with the specific product. Additionally, (s)he was informed of the benefits (rewards) one (or his/her team) would receive upon selection of the environmental friendly product, as defined by the four versions of the gamified service. The product(s) displayed as the non-game context representing stimuli and the narrative supporting the non-game context is presented in ANNEX 1: LAB EXPERIMENT.

The base game element of point enabled the response of the gamified service upon compliance with the given task. In case the user opted to select the environmental friendly product the user (or his/her team) would be eligible to receive the amount of points that would make him/her (or team) eligible to receive the reward. The interactive mockups of the gamified service manipulated the game elements (Rewards vs Gameplay mode) and the visual design and other features of the gamified application were kept constant across the four conditions other than the game elements being investigated. The four versions of the service are presented in the following paragraphs.

The first version of the gamified (Intrinsic Reward and Single play mode) service enabled the consumer (upon selection of the environmental friendly product) to receive the aforementioned points towards the individual recognition of helping the environment and achievement of becoming a “Green consumer”. The particular game element of intrinsic reward was visually represented with an achievement badge and the consumer was unable to share the badge in any online community. The second version (Intrinsic reward and Team play mode) of the gamified service enabled the consumer to receive points in order to collaborate with a

community of consumers towards a collaborative recognition of the community's effort to help the environment and achievement of becoming a "Green community".

The emphasis was given on that the personal activity and choices would contribute to the collaborative goal. The achievement was visually represented with the game element of a badge awarded to the community. The third version (Extrinsic reward and Single play mode) enabled the consumer to receive points towards individual discount on future purchases of environmentally friendly products. In this scenario the consumer was unable to share his/ her eligibility for discount in the online community. Lastly, the fourth version (Extrinsic reward and team play mode) enabled the consumer to receive points and allocate the points to the community pool of points, towards community discounts on future purchases of environmentally friendly products. As with the second version, the emphasis was given on the individual's contribution to the community goal. All four versions ensured that the introduced game elements would be functional to the degree that enabled the participants to choose whichever (from all available options) of navigation within the service and fully experience the gamification service. The design of the laboratory experiment is presented in Table 5 and the respective four mobile app visuals (Experimental Stimuli) are illustrated in Figure 15.

		Gameplay Mode	
		Single Gameplay	Team Collaboartive Gameplay
Reward Type	Intrinsic	Individual Participation and Achievement of helping the environment (Version 1)	Team Collaboration and Achievement of helping the environment (Version 2)
	Extrinsic	Individual Participation and Discount on next Purchase (Version 3)	Team Collaboration and Discount on next Purchase (Version 4)

Table 5: Experimental Design

Version 1 Version 2 Version 3 Version 4

Figure 15: Experimental Stimuli of the gamified service

5.3 Participants, Procedure and Data Collection

One hundred and eighteen participants (N=118) were recruited from an undergraduate core interdisciplinary module class at a Greek public university under voluntary participation in one of three consecutive sessions for the laboratory experiment. Participants' ages ranged from 18 to 35 years old, with a mean of 21.8 years old. Forty eight percent of the sample was female. Among the 118 participants, 10 encountered technical difficulty during the lab experiment and data of the remaining 108 participants were included in the analysis. The demographics of the laboratory experiment participants are presented in Figure 16.

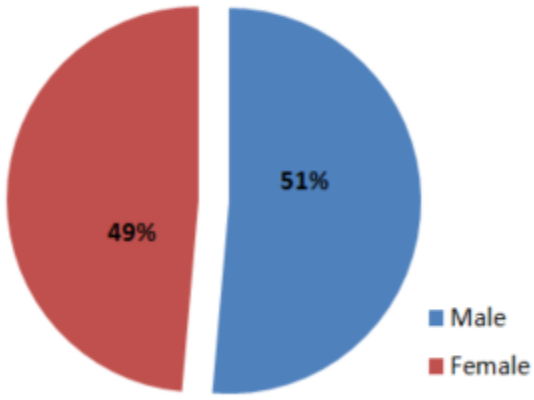


Figure 16: Demographics of the laboratory experiment participants

Upon arrival at the lab, participants completed a brief online questionnaire to gauge their demographics (Sex, Age, and Education Degree) and environmental attitudes and behaviour to control for context specific factors (degree of ecological behaviours) by adapting the Ecologically Conscious Consumer Behaviour [ECCB] instrument (Straughan and Roberts 1999) in order to account for any differences based on the participants' predispositions in relation to the non-game context. In relation to the ECCB participants rated on 7-points Likert-types scales anchored by 1="Strongly Disagree" and 7="Strongly Agree", the following statements: "I make every effort to buy paper products made from recycled paper", "To save energy, I drive my car as little as possible", "Whenever possible, I buy products packaged in reusable containers", "I try only to buy products that can be recycled", "I have switched products for ecological reasons", "When I have a choice between two equal products, I always purchase the one which is less harmful to other people and the environment", "I have tried very hard to reduce the amount of electricity I use" and "I have purchased light bulbs that were more expensive but saved energy".

Following the completion of the questionnaire, participants were randomly assigned to a version of the gamified service and each participant was invited to interact with a mock-up of the mobile application until (s)he felt that they had become confident with it. All four versions of the

application were fully functional mock-ups and the participants had the ability to interact with the assigned version to the extend each wanted as there was no predefined time constraint on the use of the application. After each participant experienced the gamified service via the functional mock-up of the application, they were invited to take a post-test questionnaire.

The measurement instruments utilized in the questionnaire, gauged users' perceived enjoyment while experiencing the gamified service, measured by adopting a scale measuring perceived enjoyment and intrinsic motivation from Epstein and Harackiewicz (1992) and Tauer and Harackiewicz (1999). Participants rated on 7-point Likert-type scales, anchored by 1="Strongly Disagree" and 7="Strongly Agree", the following statements: "The gamified service will not be interesting (reverse scored)", "The gamified service will be entertaining", "The gamified service will not be fun (reverse scored)" and "The gamified service will be enjoyable".

Additionally to perceived enjoyment, the users' attitudes and intentions towards the gamified service were measured utilizing the respective constructs Fishbein and Ajzen (1975). In order to gauge participants' attitudes towards the gamified service as well as the gamified application, participants rated on 7-point semantic differential scales, with endpoints: "Good – Bad", "Pleasant – Unpleasant", "Favorable – Unfavorable", the following statement: "In the service you experienced how would you describe your feelings towards using the service" for the gamified service and "In the smartphone application mockup you experienced how would you describe your feelings towards using the smartphone application". In order to gauge participants' intentions towards the gamified service and the smartphone application, participants rated on 7-point semantic differential scales, with endpoints: "Unlikely-Likely" and "Possible-Impossible", the following statements: "In the service you experienced how likely are you to use the service"

for the gamified service and “In the smartphone application mockup you experienced how likely are you to use the smartphone application”.

Lastly, two questions were created to ensure that participants had a clear understanding of the introduced game elements and their effect within the gamified app as follows: “Within the service you were able to share your points with a community” and “Within the service you were able to receive discounted price upon future purchase of products”.

The instruments used for data collection were tested prior to the laboratory experiment in a pilot with a small number (10 participants) of participants that suggested adequate reliability and validity and are presented in ANNEX 2: Laboratory Experiment Questionnaires.

5.4 Results

In order to assess internal consistency of the measurement instruments Internal Composite Reliability (ICR) was used. The acceptable values of an ICR should exceed 0.70 (Ferketich 1991; Nunnaly and Bernstein 1994) and can be interpreted as the Cronbach Alpha Coefficient (Chronbach 1951). The perceived enjoyment measurement instrument (4 items; a = 0.836), the ecologically conscious behaviour instrument (8 items; a = 0.830), the instrument gauging the Attitudes towards the gamified service (3 Items; a=.955) and the instrument gauging the Attitudes towards the smartphone application (3 Items; a= .958) were found to be highly reliable. Additionally, the manipulation check showed that participants correctly perceived the four different treatments.

Two-way between subjects analysis of variance (ANOVA) was conducted to test the hypotheses using SPSS 17.0 for Windows at a 95% confidence level. The descriptive statistics are summarised in Table 6, and the results from the Levene’s test for homogeneity illustrate a significance level of 0.032 (<0.05).

Gameplay Mode	Rewards	Mean	S.D	N
Team collaboration	Intrinsic	4.67	.86	30
	Extrinsic	4.62	1.04	27
	Total	4.64	.94	57
Single play	Intrinsic	3.67	1.49	27
	Extrinsic	3.95	1.42	24
	Total	3.80	1.45	51
Total	Intrinsic	4.19	1.29	57
	Extrinsic	4.30	1.26	51
	Total	4.25	1.27	108

Table 6: Descriptive statistics for perceived fun during participation in a gamified service

The results of the two-way ANOVA on the dependent variable (Enjoyment) (Table 7) show that there is significant difference among subjects that experienced different setups of gameplay mode ($F(1,108) == 12.58$, $p = 0.001$) on perceived enjoyment during participation in the gamified service. The present finding supports Hypothesis 2 at the significance level of 0.05 as participants in the treatment that employed the ability to collaborate in teams towards the rewards had a significantly higher perceived enjoyment than the ones pursuing the rewards on their own (Figure 17).

Pertaining to the Reward Type (Intrinsic versus Extrinsic) the results of the ANOVA showed no significant difference among subjects that were pursuing the Intrinsic oriented rewards (Achievement) opposed to the ones that pursued the Extrinsic oriented rewards (Discount) ($F(1,108)= .24$, $p=.624$) Hypothesis 1 is thereby not supported. The ANOVA test found no interaction effects between gameplay mode and reward type, indicating that these variables do not jointly affect perceived enjoyment during participation in a gamified service ($F(1,108)=.48$, $p=.487$).

Source	Type III sum of squares	d.f.	Mean square	F	Significance	Partial η^2	Noncent. parameter	Observed Power [b]
Corrected Model	20,153[a]		6.71	4.53	.005	116	13.602	.873
Intercept	1921.650		1921.65	1297.01	.000	926	1297.012	1.000
Gameplay Mode	18.639		18.63	12.58	.001	108	12.580	.940
Reward	.359		.35	.24	.624	002	.242	.078
Gameplay Mode * Reward	.722		.72	.48	.487	005	.487	.106
Error	154.086	104	1.48					
Total	2126.167	108						
Corrected Total	174.239	107						

(*) Signifies the interaction effect between Gameplay Mode and Reward Setting. The ANOVA test was conducted at the significance level of .05

[a] R^2 = .166 (adjusted R^2 = .090)

[b] Computed using alpha = .05

Table 7: ANOVA tests of between-subjects effects on variances on perceived experienced fun during participation in a gamified service

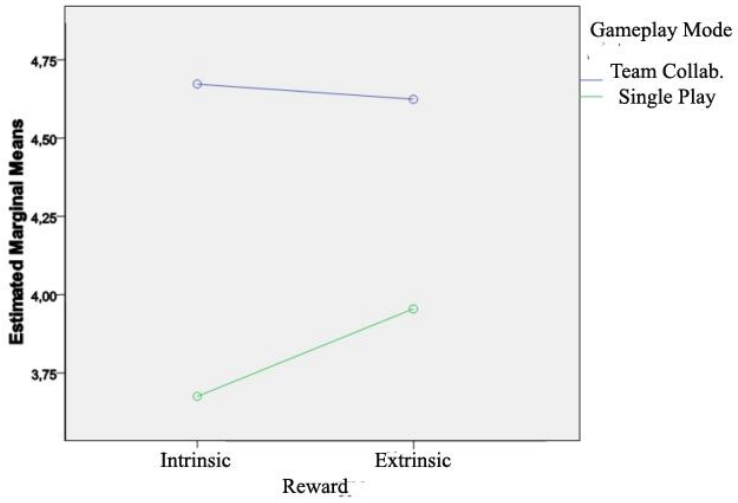


Figure 17: Laboratory experiment Estimated Marginal Means (Gamification Service Enjoyment)

between the four versions of the gamified service

In relation to the Attitudes and Intentions of the participants towards the gamified service and the smartphone application mockup a regression was calculated to predict the relationship among their respective attitudes and intentions for both the service as well as the gamified application. Pertaining to the overall gamified service, a significant regression equation was found ($F(1,106)=408.999$, $p <.000$) with an R^2 of .794. Participants' predicted intentions to participate in the gamified service is equal to -.146 + .995 (Attitudes). The participants' intention to participate in the gamified service increased by .995 for each point increase of their attitudes towards the gamified service as illustrated in Table 8.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	,891[a]	,794	,792	,800	,794	408,999	1	106	,000

a. Predictors: (Constant), Attitudes Towards Gamification Comp

b. Dependent Variable: Intentions Towards Gamification Comp

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	261,783	1	261,783	408,999	,000[b]
	Residual	67,846	106	,640		
	Total	329,630	107			

a. Dependent Variable: Intentions Towards Gamification Comp

b. Predictors: (Constant), Attitudes Towards Gamification Comp

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	-,146	,226		-,647	,519			
	Attitudes Towards Gamification Comp	,995	,049	,891	20,224	,000	,891	,891	,891

Table 8: Laboratory Experiment regression of Attitudes towards the gamified service on Intentions to participate in the gamified service.

Additionally for the smartphone application, a significant regression equation was found ($F(1,106)=20.580$, $p <.000$) with an R^2 of .163. Participants' predicted intentions to participate in the gamified service is equal to 5.889 - .503 (Attitudes). The participants' intention to participate in the gamified service dropped by .503 for each point increase of their attitudes towards the gamified service as illustrated in Table 9.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	,403[a]	,163	,155	1,610	,163	20,580	1	106	,000

a. Predictors: (Constant), Attitudes Towards Smartphone Comp

b. Dependent Variable: Intentions Towards Smartphone Comp

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	53,343	1	53,343	20,580	,000[b]
	Residual	274,758	106	2,592		
	Total	328,102	107			

a. Dependent Variable: Intentions Towards Smartphone Comp

b. Predictors: (Constant), Attitudes Towards Smartphone Comp

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	5,889	,386		15,273	,000			
	Attitudes Towards Smartphone Comp	-,503	,111	-,403	-4,536	,000	-,403	-,403	-,403

a. Dependent Variable: Intentions Towards Smartphone Comp

Table 9: Laboratory Experiment regression of Attitudes towards the smartphone application on Intentions to use it.

Further on in relation to the gamification design based on the examined game elements and the effect they had on the participants' attitudes towards the gamified service, a two-way ANOVA on the dependent variable (Attitudes towards the gamified service) (Table 10) shows that there is significant difference among subjects that experienced different setups of gameplay

mode (F(1,108)= 4.152, p = 0.045) on their attitudes towards participation in the gamified service and no significant difference based on the introduced rewards (F(1,108)=.367, p =.546) and no interaction effects between gameplay mode and reward type was found, indicating that these variables do not jointly affect the participants' attitudes towards the gamified service (F(1,108)=.093, p=.761).

Tests of Between-Subjects Effects

Dependent Variable: Attitudes Towards Gamification

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	11,402[a]	3	3,801	1,561	,203
Intercept	1989,274	1	1989,274	817,162	,000
Reward	,894	1	,894	,367	,546
GamePlay_Mode	10,108	1	10,108	4,152	,044
Reward * GamePlay_Mode	,226	1	,226	,093	,761
Error	253,174	104	2,434		
Total	2277,438	108			
Corrected Total	264,576	107			

a. R Squared = ,043 (Adjusted R Squared = ,015)

Table 10: ANOVA tests of between-subjects effects on variances on attitudes towards participating in the gamified service

Additionally, in relation to the gamification design based and the effect on the participants' attitudes towards the gamified smartphone application, a two-way ANOVA on the dependent variable (Attitudes towards the gamified service) (Table 11) shows that there was no significant difference among subjects that experienced different setups of gameplay mode (F(1,108)= 2.999, p = 0.086) or introduced rewards (F(1,108)=2.848, p =.094) and no interaction effects between gameplay mode and reward type was found, indicating that these variables do not separately or jointly affect the participants' attitudes towards the smartphone application (F(1,108)=.262, p=.610).

Tests of Between-Subjects Effects

Dependent Variable: Attitudes Towards the Smartphone application

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	11,356[a]	3	3,785	1,972	,123
Intercept	1106,576	1	1106,576	576,445	,000
Reward	5,468	1	5,468	2,848	,094
GamePlay_Mode	5,758	1	5,758	2,999	,086
Reward * GamePlay_Mode	,503	1	,503	,262	,610
Error	199,644	104	1,920		
Total	1306,941	108			
Corrected Total	211,000	107			

a. R Squared = ,054 (Adjusted R Squared = ,027)

Table 11: ANOVA tests of between-subjects effects on variances on attitudes towards the smartphone application

Pertaining to the non-game context control the two-way ANOVA tests on the ECCB control variable showed that there was no significant difference between the treatments in respect to the environmentally conscious consumer behaviour that could have potentially affected the results ($F(1,108) = 1.533$, $p = .221$). Lastly, in terms of the demographic control variables (Age, Sex and Education Degree) for the treatment groups, no significant difference between the treatments was found. A summary of the results of the Hypothesis is presented in the following table.

Hypothesis	Significance	Evaluation
H1: Intrinsic oriented rewards will lead to higher enjoyment during participation than extrinsic.	0.624	Not Supported
H2: Team based collaboration towards rewards will lead to higher enjoyment during participation than Single play.	0.001	Supported [a]
[a] Supported at the 0.05 level		

Table 12: Summary of hypothesis testing

5.5 Discussion

The purpose of the laboratory experiment was to experimentally test two different game elements that were identified to have the possibility to motivate participants to engage with gamified service of the non-game context however were different in nature with initially dichotomized results, on the interviews and focus groups. As participants identified the game element of rewards to be motivating in both monetary version and achievement version and in parallel with research that classifies the two different rewards in an opposite spectrum of motivational rewards (Extrinsic rewards and Intrinsic rewards) with rewards of extrinsic nature having found undermine intrinsic motivation (DeCharms 1968) , research was conducted to identify the effect it can have on the gamification of the non-game context. Additionally, the way that the rewards are pursued normally in the non game context although are predominately addressing the individual, in game design literature a significant benefit derives from the common (in teams) pursuit of the rewards. Therefore a two by two experimental setting was designed to identify the potential of Rewards (Intrinsic vs Extrinsic) and Gameplay mode (Single play vs Team play) on Perceived Enjoyment (as means to Intrinsic Motivation).

An important finding of the study, is that in a gamified service the ability of participants to collaborate with other participants in a community setting towards the pursuit of common goals presents statistically significant difference in the perceived enjoyment, in comparison to individual pursue of rewards. The element of community collaboration towards the pursuit of common rewards can be found in online games and the Massively Multiplayer Online Games genre in particular where players are enabled to collaborate with other players by creating teams, groups and guilds towards the completion of a common activity and the achievement of a common goal (Ducheneaut 2006; Kong et al. 2012; Yee 2006). This is consistent with the research of Ryan et al. (2006) proposing that whilst playing, individuals should experience, amongst others, relatedness referring to a sense of connection to other people via the game itself. That connection, as experienced by the individual's contribution to a collaborative effort towards a goal, can be seminal to the impact of a gamified service on individual's experienced enjoyment during participation. In online games, community collaboration is an established setting for player participation and results indicate the potential for transferability of the specific design game element to the gamification of services. Although in the case that community collaboration and team formation is extant and was found to have a significantly different result on enjoyment, the attitudes towards participating in the gamified activity showed an opposite result which was statistically significant. Participants that were playing in single play mode stated higher attitudes towards participating in the gamified service than the ones in team gameplay mode. This contradiction identified namely although enjoying more in team gameplay mode but having a higher attitude towards participating in single play mode could be a result of an inherent difference in the difference stemming from playing in teams opposed to playing individually. In games although teams are formed behind the common pursuit of rewards, it is implied that other

teams exist as well that shout after the same rewards, creating a competitive setting. In the laboratory experiment in the single mode of gameplay, the subjects did not have a competitive aspect in it in any sort of manner, however in the team game play mode (although not stated) a team competition could be perceived by the participants to be extant. On that note, and in parallel to the findings of the interviews and focus groups further research on the game element of competition will be conducted.

An additional finding that presents potential derives from Hypothesis 1 that was not supported. The gamification service employed strongly contradictory (in terms of intrinsic and extrinsic orientation) rewards, that of Achieving to help the environment or Receiving discounted prices respectively. Results on the introduced contradictory versions of the game element of rewards, illustrate that participants' perceived enjoyment of the gamified services was not statistically significantly different when pursuing two such contradictory rewards. This finding can guide the creation of the rewards content of the gamified application as it enables the gamified service to employ either and base the selection on other factors (e.g. Availability to give rewards that have a cost).

Lastly in terms of the predispositions of participants on the non-game context results indicate that they did not play a role in the perceived enjoyment during participation. Therefore the non-game context was not found to factor in and the gamification design of the lab experiment was not affected by the participants tendencies towards the environment.

Chapter 6: Assessing the Impact of Gamification Design on Engagement and Performance

6.1 Hypothesis Development: SDT and Game Elements Design towards motivating for Engagement and Performance

The laboratory experiment indicated that different game elements under a gamification design can have a different outcome in the participants' experienced enjoyment during participation in a gamified service. This led us to identify the need for further experimentation to examine for the potential of game elements and gamification to motivate participants to actually engage and perform with the gamified electronic service of the non-game context. According to Self Determination Theory, in order for an experience to be intrinsically motivating for the participants to engage with, three basic human needs can be satisfied, Competence, Autonomy and Relatedness. Competence refers to feelings of success when the individual interacts with the given task (Rigby and Ryan, 2011; Vansteenkiste and Ryan, 2013), Autonomy refers to the feelings of individuals that they are free to interact on their own will with the given task and are not thwarted by external factors (van den Broeck et al., 2010; Vansteenkiste et al., 2010) and lastly Relatedness refers to individuals' feeling of belonging in a group that they feel are close to them (Deci and Ryan, 2000; Deci and Vansteenkiste, 2004). The aforementioned three intrinsic psychological needs of humans which are motivational resources can be supported (or developed) by modifying the environment under which the task participation is conducted. Therefore gamification can utilize the different game elements under different gamification designs to facilitate the development of intrinsic motivation through meeting the three basic

psychological needs as means to foster engagement with the non-game context at hand as seen in Figure 17.

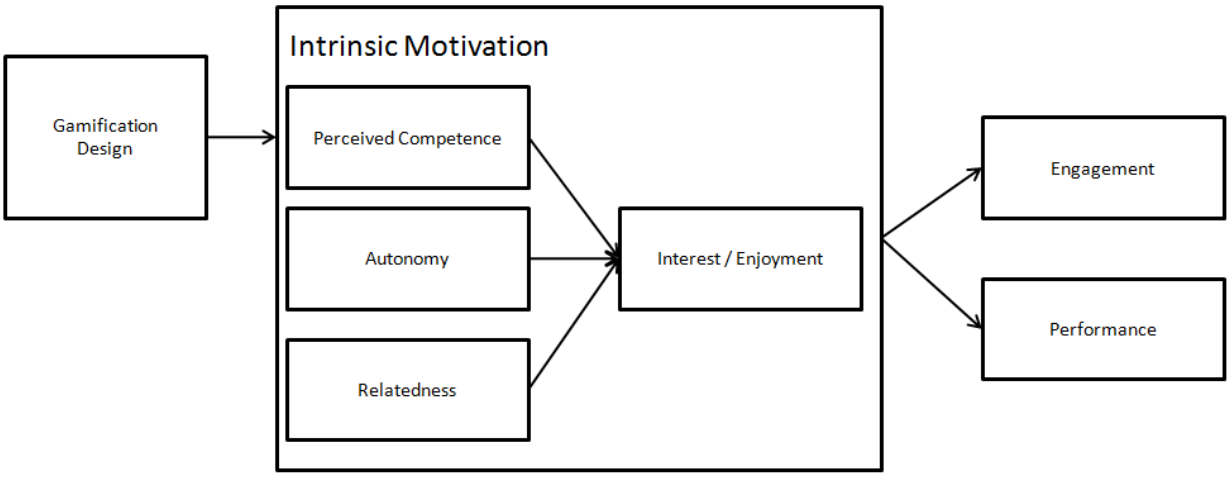


Figure 17: Gamification Design and Motivation

Based on the results of the exploratory phase of this doctoral research two additional (to the laboratory experiment) game elements were found to have potential to motivate engagement but in a dichotomized way, namely the presence (or absence) of competition through the existence of other participants in the gamified service and difficulty levels on obtaining the rewards (progressively difficult or progressively easy).

In terms of the difficulty of the gamified tasks and the overall challenge posed to the participants of the gamified service, previous work in motivation research and game research has shown the importance of the appropriate matching of challenge (through difficulty) to the skill of the individual on the task as means for motivation development. The combination of challenge to skill is evident in (video and online) games through the different difficulty levels that are employed traditionally. In positive psychology, Mihaly Csikszentmihalyi described the state of 'flow' as a state that is achieved when a person is fully involved in an activity due to the optimal

balancing of challenge and skill (Csikszentmihalyi, 1991). This dynamic balance of challenge to skill is the core element of flow and in order for an individual to experience flow, the challenge and difficulty of the task one is invited to complete and the skill required to meet it need to be correlated (Jackson, 2012). This balance is termed 'Flow Zone' (Figure 18). If one finds himself/herself above Flow Zone and the challenge posed by the activity is more than the skill (s)he has then (s)he feels anxious and is not motivated to engage. On the opposite side if one finds himself/herself below Flow Zone and the challenge posed by the activity is less than the skill (s)he already has then (s)he feels boredom. However both conditions and respective results rely on the individual perceptions of the participants on the challenge and the skill and not in an objective analysis.

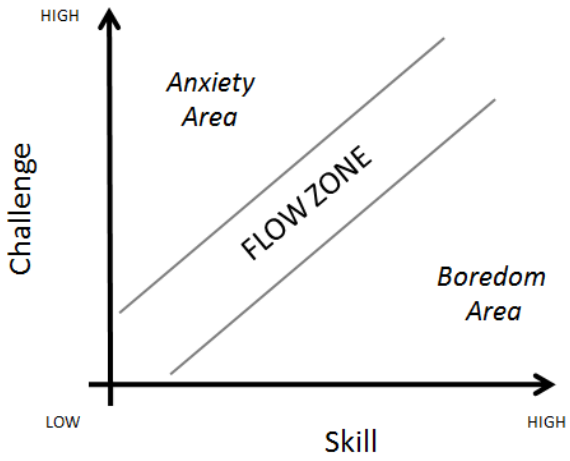


Figure 18: Csikszentmihalyi's Flow Zone (1991)

In games, the concept of flow and subsequent need for challenge-skill matching has been met with the utilization of different difficulty levels and difficulty progression. In particular, games offer levels of difficulty as means to balance the player skills and as such become engaging as the player becomes competent at the requested game tasks (Honey et al. 2011). The aforementioned adaptation of difficulty to meet the skill of the player has evolved in the game

design literature to include additional forms of difficulty adaptations to cater to different types of players. Two main categorizations include Static Difficulty Adaptation and Dynamic Difficulty Adaptation. In Static difficulty adaptation the progression of difficulty can occur in an increasing manner where difficulty increases progressively after specific points in the game (*PLATEAU*) and in a decreasing manner where difficulty start high and decreases over time after specific points in the game (*REVERSE*) (Nagle et al. 2016). A later evolution to the static difficulty adaptation is the dynamic difficulty adaptation which takes under consideration individual players' abilities and skills and adjusts the difficulty of the game tasks. This is conducted in different ways with most prominent being the game to automatically change the difficulty of a game task relative to the user performance (Barnes et al.,2009) or even with the use of artificial intelligence models to select the levels of the difficulty in real time as the game progresses (Spronck et al., 2006). Although the game design literature provides with different forms of difficulty adaptation to enable optimal challenge, current research on gamification focuses on the traditional difficulty adjustment of PLATEU where the difficulty is progressively upwards as the individual progresses through the gamified activity (Zichermann and Cunningham, 2011; Werbach & Hunter 2012; Barthel, 2013; Popescu et al., 2013; Sillaots, 2014). The aforementioned focus of gamification and in parallel with the findings of the depth interviews and focus groups (Participants also opting for easier tasks) leads us to identify the potential for the REVERSE difficulty adaptation method to motivate for engagement. The overall difficulty adaptation will factor in to the Perceived Competence of the participant during the gamified activity. The dichotomy of the challenge to become progressively difficulty versus progressively easier, should cater on the one hand to the evolving skill of the participant should the difficulty follow the PLATEU approach of progressively upwards difficulty or REVERSE where the skill

of the participant will be more evident and his/her perceived competence would be evident as means of manipulating the difficulty of the gamified task. As in both cases the optimal challenge relies heavily to ones' perception of that balance (challenge-skill) as a reference point, progressive upwards difficulty could be subjectively considered to be 'too difficult' and lead to anxiety or on the other hand progressive downwards difficulty could be considered to be 'too easy' and lead to boredom, both having a negative effect on perceived competence and subsequently engagement and performance. In order to negate that and create a more objective setting in the difficulty design, we could introduce the effect of each players actual performance relative to other players (Social Comparison) as means to allow for a more subjective perception of competence.

In motivation research a strong motivator that has been studied relates to the social comparison that derives from competition and its ability to motivate participants to pursue a goal and attain a predefined reward (Tjosvold et al., 2006; Vallerand and Losier, 1999). The case is though that although competition is one of the main game dynamics employed in different gamification designs as means to motivate for engagement, previous results present mixed outcomes on the impact of competition on motivation. For example the existence of competition in the case of a Wii Fit game led to demotivation to play the game, opposed to the absence of competition that led to positive results pertaining to motivation to play (Song et al.,2010). On the other hand, the introduction of a competitive setting has been found to have positive effects on motivation based on the task at hand (Epstein and Harackiewicz, 1992; Reeve and Deci, 1996). In Gamification the most prominent element to enable a competitive setting and social comparisons is the leaderboard showcasing the current ranking of each player as well as the in-game competing players (Blohm and Leimester 2013).

Both game mechanics, difficulty and competition in gamification independently adhere to the Perceived Competence (Aparicio et al.,2012) however when utilized in unison could support (or develop) Perceived Competence differently. In the case of incremental difficulty the absence of competition and social comparison would lead to perceived competence to be affected only by the perceptions of the individual whilst progressing in the game and in the case one is exposed only to the effect of success or failure to progress in the gamified task and not comparative to other players, actual performance issues at later stages may lead to anxiety. On the other hand if one is aware of the competition and the competitors' performance as the gamification tasks become progressively difficult his/her success will have a higher impact on their perceptions of competence. In the case of progressively decreasing difficulty, the absence of competition and social comparison would lead to perceived competence to be higher as the participant will have a sense of gaining skills quickly as a result of succeeding in the gamified tasks easier. Should competition and social comparison is enabled, that feeling of increased perceived competence will be further validate by his/her over performing in relation to the competitors. Therefore we propose:

Hypothesis 3: In a Gamified Service, in the presence (absence) of competition and social comparison, increased (decreased) difficulty will lead to higher Perceived Competence for the participant

Hypothesis 4: In a Gamified Service, in the presence (absence) of competition and social comparison, increased (decreased) difficulty will lead to higher Engagement with the service

Hypothesis 5: In a Gamified Service, in the presence (absence) of competition and social

comparison, increased (decreased) difficulty will lead to higher Performance in the gamified activity

As the game elements of difficulty and competition adhere to the manipulation of perceived competence as hypothesized above, and lead to different psychological outcomes, we hypothesize that the gamification design will lead to the desired behavioral outcomes through enabling the psychological outcome of perceived competence in the gamified activities included in the gamified electronic service as follows:

Hypothesis 6: In a Gamified Service, perceived competence will mediate the effect of gamification design to the behavioural outcomes of the end –users

Although the game mechanics of difficulty and competition relate to Perceived Competence when examined under Self Determination Theory, Autonomy and Relatedness should be taken under consideration. When designing a gamified service that is introducing different difficulty settings, the participants should not feel thwarted when using the service and have the ability to navigate freely and on their own will within the gamified tasks and therefore the need for autonomy should be examined for the case it becomes affected. Additionally, in relation to Relatedness as this refers to individuals' feeling of belonging in a group that they feel are close to them in the case of competition with other participants that are not close to the individual relatedness should not factor in. On the other hand relatedness as means to enable motivate can come into play in the case of collaborative gamification setting in team based setup and the way the teams are formed. The model of this doctoral research is presented in Figure 19.

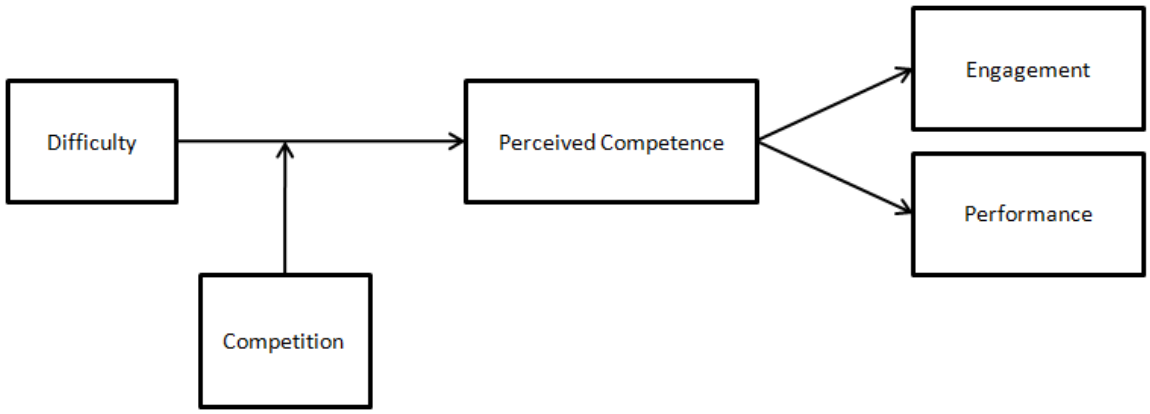


Figure 19: Moderated mediation between gamification design, perceived competence and behavioural outcomes.

6.2 Method

6.2.1 POOLL:The Gamification Experimentation Smartphone Application and Infrastructure

In order to test the effect of the game elements on perceived competence and ultimately on performance and engagement a gamified service was developed to enable the parallel application of the different game-elements. The goal of the service was to enable gamification experimentation on different game elements with the ability to enable and disable game elements and serve them on different participant groups based on the needs of different experimental designs. The service consisted of a smartphone mobile application, serving as the access point of the end-user to the gamified activity and the respective backend that would manipulate the game-elements introduced in the gamification design. Additionally the backend was responsible for the user management, serving of the content of the gamified activity as well as logging of all user

actions within the application for further analysis. The gamification experimentation smartphone application was developed in ELTRUN E-Business R.C. and served under the name *POOLL: A Pool of Poll* and was developed as a gamified service to cater to the non-game context of this study.

6.2.1.1 Non-game context and POOLL content

As gamification is a layer of playful affordances over an electronic service on a non-game context, the POOLL experimentation application facilitates the introduction of the gameful affordances over the content that handles the non-game context. Therefore the non-game context in the application is separated to the gamification design. For the purposes of this doctoral research and in parallel to the focus group outcomes, the overall theme of the POOLL application resembles a quiz based game where the participants receive a set of environmental awareness questions and up to four different possible answers and they can give their answer via selecting one of them. Upon answer (Correct or Wrong) they receive respective feedback. Additionally and to cater for the reception of users' perceptions of product "greenness" on different products, the user can answer in the form of a slider input anchored from 1-100 (1 being the lowest). The questions functionality of the POOLL application and backend infrastructure enables the bundling of different questions into different sets and the randomized serving of questions as well as the maintenance of the order served, the time each participant spend reading / answering the questions, the ability to skip a question and the ability to add a question to favorites.

6.2.1.2 POOLL Mobile application and Game Elements

The mobile client application utilized in the gamification experimentation is a cross-platform application, developed and deployed both for Android and iOS platforms, utilizing the Apache Cordova open source framework and along the back end infrastructure was developed in the context of the e-SAVE project. The POOLL application is a mobile application that served the different gamification designs under different experimental conditions. The game elements POOLL is able to serve include Points awarding functionalities, Badges functionality, a Leaderboard, Levels/Difficulty functionality, Rewards Functionality, Feedback / Notifications functionalities, Questions-Answers functionalities and the main functionality, that of dynamic presentation of User Interface elements based on the user groups. A short description of the game elements supported by POOLL mobile application is presented in Table 13.

Game Element / Functionalities	**Description**
Point Awarding	Experience points can be awarded on different actions based on successful completion. The experience points tallied can be visible in the respective placeholder.
Badges Awarding	Different badges can be awarded for the completion of bundles of actions. A badge is consisted of a visual part (the badge graphic), a name and a badge description.
Leaderboard	A leaderboard is included in the game element as a table of three columns and three rows showing the overall rank in the app in the first column, the username in the second column and the Points in the third column. Rows are utilized to show the logged-in user in the middle row

	and the users directly in front and following (in terms of ranking)
Levels / Difficulty	Levels are introduced to bundle the non-game context's content in different difficulty setups. The difficulty is based on effort required to complete the level and is manipulated by the use of the points as means to receive a reward.
Rewards	Rewards in the application are introduced as a conceptual game element that can be served as a badge, or as a set of points.
Feedback/Notification	Upon answering questions the user can receive respective feedback.
Questions-Answers	Different questions can be linked with answers and feedback / points / rewards.
Dynamic Presentation of UI	All game elements can be shown or hidden on different groups of users based on the reallocated setting of the user group, users belong to. This feature can enable within and between experimentation.

Table 13: POOLL Game elements and Functionalities

6.2.1.3 POOLL Backend enabling experimentation

The backend of POOLL is built to dynamically manage the users and their placement in the experimental user groups in order to enable between and within experimental design. Each group has different configurable parameters that guide the mobile client User Interface ability to enable (or disable) the respective manipulated game elements. Indicatively, the class diagram in Figure 20 showcases parts of the classes that enabled the versioning in the mobile app. Indicatively the main classes that are used in the back-end are presented in the following:

- **User class** represents users of the experiment where each user has his/her own UID, a First and a Last Name, Password, age, and email and is related to one user group.
- **Usergroup class** represents the user group of experimentation and each user group has parameters for enabling the game elements (e.g. Leaderboard, showing Badges etc.).
- **Question, Answer and Question Category classes** relate the non-game context questions, respective answers and category.

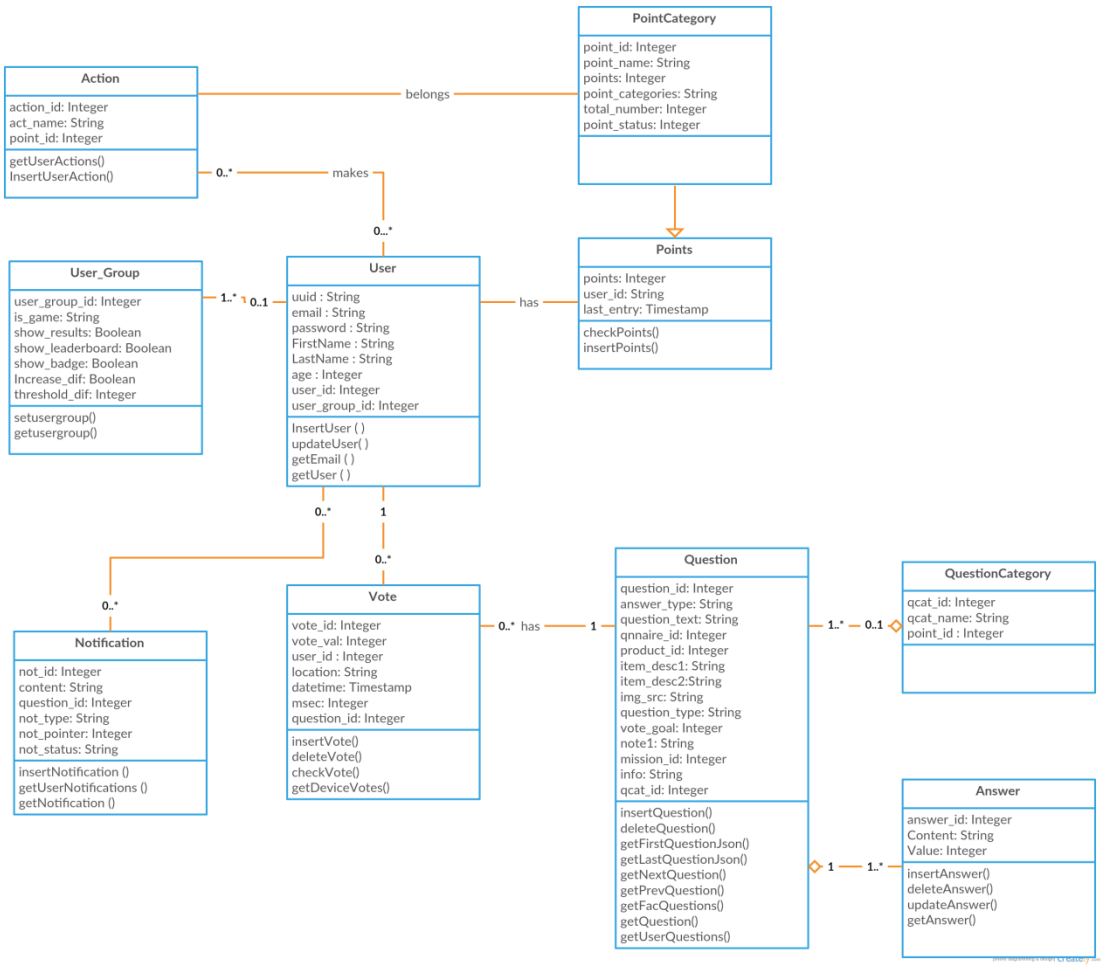


Figure 20: Class diagram of the backend supporting the experimental app

6.2.2 Experimental Design and Setting

In order to examine the effect of these two game elements on participants' perceived competence and later on engagement and performance in the gamified activity, a two (Competition type) by two (Difficulty progression) experimental design was utilized, through the fully functional gamification experimentation application as illustrated in Table 14.

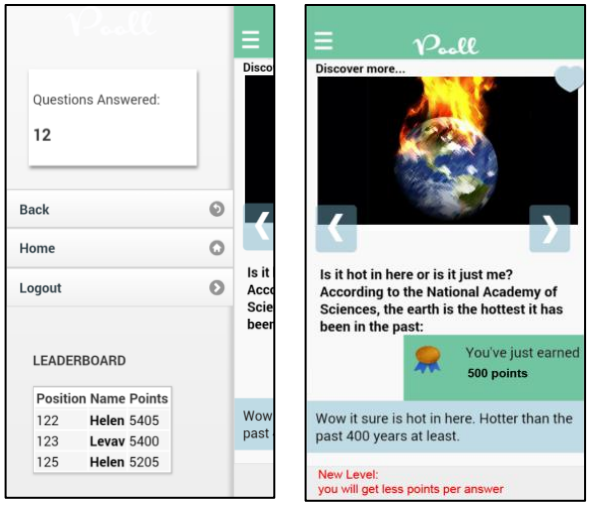
To elaborate on the design, the gameplay type framed a competitive setting, where the participant was made aware of the existence of other players in the gamified app via the employment of a leaderboard and social comparison was enabled, or the absence of a competitive setting, where the participant experienced the gamified app as a single player game with no other participants present. Additionally, the difficulty progression featured increasing difficulty, on the one hand, to achieve the goal of answering questions and receiving a point reward and decreasing difficulty, on the other hand, in receiving the point rewards through answering questions.

		Difficulty Type	
		Increasing	***Decreasing***
Competition Type	***Competition YES***	Competition Available and Increasing Difficulty (Figure 21.1)	Competition Available and Decreasing Difficulty (Figure 21.2)
	Competition NO	Competition Non-Available and Increasing Difficulty (Figure 21.3)	Competition Non-Available and Decreasing Difficulty (Figure 21.4)

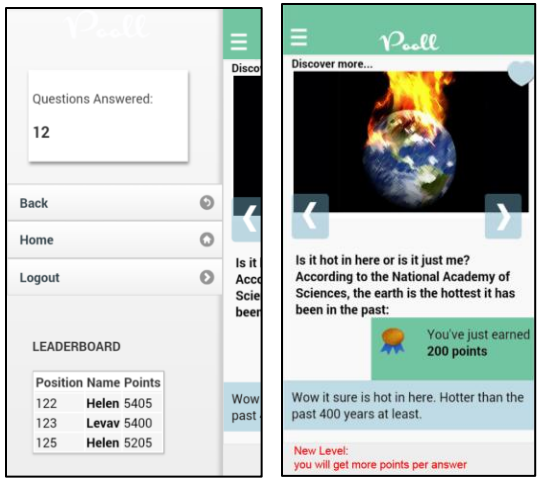
Table 14: Experimental Design

Utilizing the ability of the mobile client to Show or Hide different elements based on user groups, the POOLL up locked upon user registration in one out of the four versions. In particular, the first version of the app gave the ability to the user to see her/his position in a three-slot leaderboard, where (s)he was featured in the middle position and the players directly before and after her/him were visible. In this version, as the game progressed it became more difficult to receive points for answering bundles of questions in the respective levels. The second version featured the same leaderboard as the first, however as the game progressed it became easier to receive points for answering bundles of questions in the respective levels. In the third version, there was no leaderboard present and no other means for the user to identify that (s)he is in any competition and the difficulty increased, as the game progressed, through the levels. Lastly, in the fourth version as in the third, competition was inexistent, however the difficulty decreased as the game progressed through the levels.

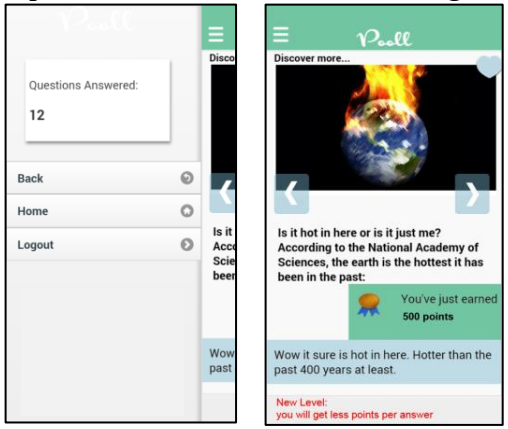
The four different versions that were included in the experimental app are illustrated in Figure 21.



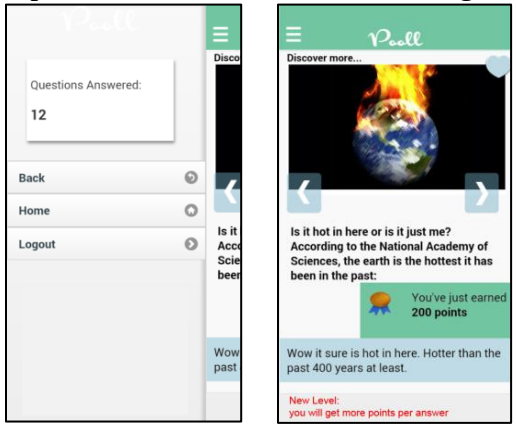
V1. Competition Available and Increasing Difficulty



V2. Competition Available and Decreasing Difficulty



V3. Competition Non Available and Increasing Difficulty



V4. Competition Non Available and Decreasing Difficulty

Figure 21: The four versions of the experimental app

Pertaining to the operationalization of the content of the POOLL application for the field experiment and with respect to the environmental awareness part of questions, a total of fifty seven sets of question/answer/feedback were created and for the product greenness part of the non-game context a total of fourteen products were introduced (Product Name, Description, Environmental information). The environmental awareness questions were bundled into different Question sets and within each set the questions are served at a random order. In-between the environmental awareness set, the product perceptions questions were presented., Indicative questions pertaining to environmental awareness and product greenness perceptions are presented in Table 15 and the complete set of questions is presented in ANNEX 3: POOLL non-game context questions.

Question	Answers	Feedback
Which of the following modes of transportation is the most environmental friendly?	By Bus / By Car	Taking the bus and in general using public transportation can reduce the greenhouse emissions.
Splish splash, teeth are clean. Should I turn off faucets when I brush my teeth?	YES / NO	By turning off faucets that are running unnecessarily (like when brushing our teeth) we actively help the environment
USA or China or Greece produces the most greenhouse gas emissions?	USA / China / Greece	At the top of the list of global greenhouse gas emitters China beat USA and Greece in 2006-07 because of the rising industrial sector.

Table 15: Indicative questions reflecting the non-game context of the POOLL Experimentation Application

6.2.3 Participants and Procedure

In the field experiment conducted, 153 (44,4% Female) participants were recruited randomly from undergraduate and post-graduate core interdisciplinary classes at a Greek public university. The participation to the experiment was on a voluntarily basis and no incentives for participation existed. The participants' ages ranged from 18 to 35 years old. Among the 153 participants, 9 encountered technical difficulties using the mobile app during the field experiment. Data from the remaining 141 participants were included in the analysis of the experiment. Upon acceptance to participate in the experiment, participants were invited to complete a short online questionnaire to gauge their demographics including sex, age and education degree and participants' attitudes and behavior relevant to our non-game contexts' characteristics.

Following the completion of the brief online questionnaire, participants were invited to download and install the gamified app (iOS and Android versions), register and on their own engage with it. No prerequisites or instructions were given to the participants relevant to the time, duration or location of gameplay and they were left on their own to engage with the gamified app wherever, whenever and for as long as they opted to do so. Upon registration, each participant was randomly assigned in the backend to a version of the app, which was in turn used to enable or disable the competitive setting catering to the mode of play and set the difficulty in progressing in an increasing or decreasing manner. With the aforementioned allocation, the manipulated game elements were initialized and the gamified app "locked" in one of the four fully functional versions, where it remained for the entirety of the gameplay. In the case that a participant logged out, or changed a device, with the use of her/his credentials, the version that (s)he was assigned to was loaded making her/him experience the same version of the gamified

service. During the experimentation phase, constant monitoring enabled us to identify when each participant had completed her/his participation. After each participant had engaged with the app, and became inactive for five consecutive days, (s)he was invited to take a post-test online questionnaire. The questionnaire gauged their perceived competence in the gamified activity, the degree of their felt relatedness and autonomy, their overall interest and enjoyment during participation and their attitudes and intentions towards the continuing participating in the gamified activity and the gamified activity and respective smartphone application.

6.3 Data Collection and Measures

Environmental Conscious Consumption Behaviour. Pertaining to the non-game context the Ecologically Conscious Consumer Behaviour [ECCB] instrument (Straughan and Roberts 1999) was utilized to gauge participants' predispositions in relation to the non-game context. In relation to the ECCB participants rated on 7-points Likert-types scales anchored by 1="Strongly Disagree" and 7="Strongly Agree", the following statements: "When there is a choice, I always choose the product that contributes the least to environmental pollution.", "If I understand the potential damage to the environment that some products can cause, I do not purchase these products", "I normally make a conscious effort to limit my use of products that are made of scarce resources" and "When there is a choice between two equal products, I always purchase the one which is less harmful to other people and the environment".

In order to measure Interest/Enjoyment, Perceived Competence, Autonomy and Relatedness the respective subscales of the Intrinsic Motivation Inventory were utilized (Deci et al., 1994; Ryan et al., 1991; McAuley et al., 1987; Plant and Ryan, 1985; Ryan et al., 1983) as follows:

Intrinsic Motivation. In order to measure the intrinsic enjoyment of the participants in the gamified activity the subscale of Interest/Enjoyment was utilized as this subscale is the self reported measure for Intrinsic Motivation and participants rated on 7-points Likert-types scales anchored by 1="Not at all true" and 7="Very true", the degree of how true each of the following statements are to them: "I enjoyed doing this activity very much", "I thought this was a boring activity [Reversed]", "This activity did not hold my attention at all [Reversed]" and "I would describe this activity as very interesting".

Perceived Competence. In order to measure the perceived competence of the participants in the gamified activity the subscale of Perceived Competence was utilized and participants rated on 7-points Likert-types scales anchored by 1="Not at all true" and 7="Very true", the degree of how true each of the following statements are to them: "I think I am pretty good at this activity", "I think I did pretty well at this activity, compared to other participants" and "I am satisfied with my performance in this activity".

Autonomy. In order to measure the degree of experienced autonomy of the participants in the gamified activity the subscale of Perceived Choice was utilized and participants rated on 7-points Likert-types scales anchored by 1="Not at all true" and 7="Very true", the degree of how true each of the following statements are to them: "I felt I had to do this [Reversed]", "I answered the questions because I had no choice [Reversed]" and "I did this activity because I wanted to".

Relatedness. In order to measure the degree of experienced relatedness of the participants in the gamified activity the subscale of Relatedness was utilized and participants rated on 7-points Likert-types scales anchored by 1="Not at all true" and 7="Very true", the degree of how true each of the following statements are to them: "I felt very distant to the other participants of

the activity [Reversed]", "I feel close to the other participants in this activity"," I'd like a chance to interact with the participants of Pooll" and "I don't feel like I could really trust the participants of Pooll". Lastly in the post-experimentation questionnaire, manipulation check questions were introduced to ensure that participants had a clear understanding of the introduced game elements and their effect within the gamified app as follows: "The more I was answering questions the easier it was to get points" and "In the Pooll app I was able to compare my performance with other players". Besides the questionnaire items, engagement with the smartphone app was measured via the overall time that each participant spent within the app. In order to enable that, the in-app behavior was logged per page and per question and logged in Msec that was associated with each anonymized user. Performance is measured by the total number of points each participant received by answering questions which was the overall task of the gamified activity. All instruments used in the study for data collection, as well as the developed experimental app, were tested prior to the application on the experiment in a pilot study with a small number of participants which suggested adequate reliability and validity for the instruments and bug-free operation of the experimentation app. The instruments utilized in this study can be found in ANNEX 4: Field Experiment Questionnaires

6.4 Results

In order to assess internal consistency of the measurement instruments, internal composite reliability was used, interpreted as the Cronbach Alpha Coefficient (Chronbach, 1951), with acceptable values of over 0.70 (Ferketich,1991; Nunnaly 1994). Regarding the measurement instruments, the Ecological Conscious Consumer Behavior instrument (4 items, a=0.792), the Interest/Enjoyment instrument of SDT IMI inventory (4 items, a=0.813), the Perceived Competence instrument of SDT IMI inventory (3 items, a=0.611), the Perceived

Choice instrument of SDT IMI inventory measuring Autonomy (3 items, a=0.607) were found to be reliable. As the game elements included in the gamification design of the experiment did not place the end-users in a setting where Relatedness as a sense of belonging would be supported the Relatedness instrument of SDT IMI inventory (4 items, a= -0.24) was not found reliable as it was irrelevant to the gamification design including the specific game elements and therefore not included in the subsequent analysis. Additionally, the introduced manipulation checks showed that the participants correctly perceived the four different versions of the gamified app.

6.4.1Effects of Gamification Design on Engagement.

Two-way between subjects analysis of variance (ANOVA) was conducted to test for the effect the different gamification design (Difficulty and Competition) had on overall engagement with the gamified app, using SPSS 23 for Windows at a 95% confidence level. The descriptive statistics are summarized in Table 16, and the results from the Levene's test for homogeneity illustrate a significance level of .367 (>0.05).

Difficulty Setting	Competition Setting	Mean	Std. Deviation	N
Decreasing Difficulty	Competition Yes	1812954,39	1318809,699	36
	Competition No	1956033,72	1149756,021	36
	Total	1884494,06	1230541,036	72
Increasing Difficulty	Competition Yes	2355833,52	1213194,474	31
	Competition No	1539375,71	1005143,753	38
	Total	1906190,09	1168944,994	69
Total	Competition Yes	2064137,27	1290632,454	67
	Competition No	1742074,20	1090800,916	74
	Total	1895111,26	1196555,791	141

Table 16. Descriptive statistics for overall engagement (in ms) under the different gamification architectures

The results of the ANOVA on the dependent variable of overall engagement, presented in Table 17, indicate that there is a significant difficulty setting * competition setting interaction, while neither the main effect of difficulty nor the main effect of competition was significant. The main effect for Difficulty setting yielded an F ratio of F(1,137) = .101, p > .05, indicating that there was no significant difference between Decreasing Difficulty setting (M = 1884494, SD = 1230541) and Increasing Difficulty setting (M= 1906190, SD=1168944).

The main effect for Competition setting yielded an F ratio of F(1,137) = 2,885, p > .05, indicating that the effect for Competition was not significant for Competition Existing (M = 2064137, SD = 1290632) and Competition Not Existing (M= 1742074, SD=1290632). The interaction effect was significant, F(1,137) = 5,858, p< .05.

Posthoc tests found no significant effect of difficulty setting in the cases of competition existing F(1,67)=3,038, p>.05 and not existing F(1,67)=2.762 p>.05.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	11765637323589,781[a]	3	3921879107863,260	2,848	,040
Intercept	514678215424185,940	1	514678215424185,940	373,709	,000
Difficulty	139593905485,844	1	139593905485,844	,101	,751
Competition	3973021228464,331	1	3973021228464,331	2,885	,092
Difficulty * Competition	8067259128608,562	1	8067259128608,562	5,858	,017
Error	188678769209613,470	137	1377217293500,828		
Total	706838390798688,000	141			
Corrected Total	200444406533203,250	140			

Table 17: ANOVA tests of between subjects effects on variances on engagement during participation in the gamified app

The aforementioned results support Hypothesis 4, where it was proposed that in a Gamified Service, in the presence (absence) of competition and social comparison, increased (decreased) difficulty will lead to higher Engagement with the service. As illustrated in Figure 22, subjects who participated in the gamified architecture that employed a leaderboard as means to showcase competition, became more engaged when it was complemented by an increasing difficulty in progression towards the goal to raise points, rather than a decreasing difficulty. The exact opposite stands for the case of the gamification architecture that lacked a competitive setting and the player was unaware of the existence of other players. In that version of the app, the subjects became more engaged when the difficulty setting was decreasing as opposed to increasing.

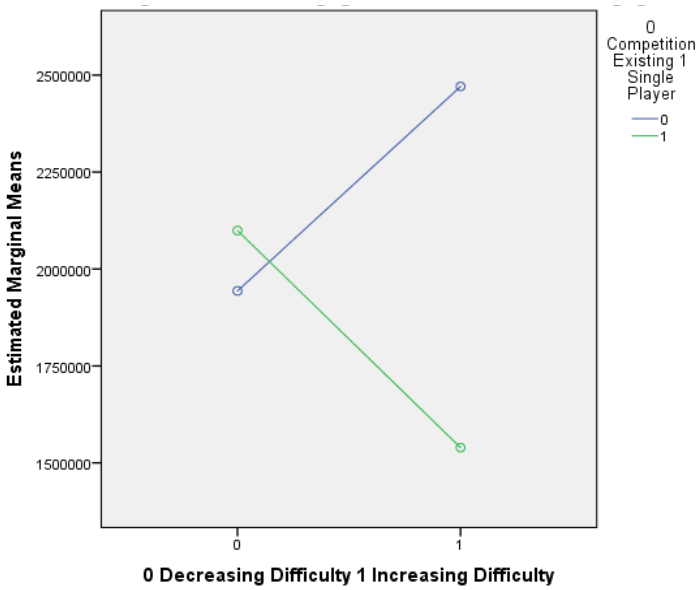


Figure 22: Estimated Marginal Means of Engagement (in Msec)

6.4.2. Effects of Gamification Design on Performance

In terms of participants' performance and the effect of the game elements, a two-way between subjects analysis of variance (ANOVA) was conducted to test for the effect the different gamification design had on the overall performance (measured in the points) each participant was rewarded through engaging with the gamified task of answering questions. The descriptive statistics are summarized in Table 18.

Difficulty Setting	Competition Setting	Mean	Std. Deviation	N
Decreasing	Competition Yes	8190,44	3222,637	36
	Competition No	9266,86	5188,154	36
	Total	8728,65	4322,294	72
Increasing	Competition Yes	14407,45	11765,941	31
	Competition No	7118,05	8768,496	38
	Total	10393,00	10781,980	69
Total	Competition Yes	11066,97	8842,401	67
	Competition No	8163,42	7283,170	74
	Total	9543,12	8163,119	141

Table 18. Descriptive statistics for overall performance (in points gained) under the different gamification designs

The results of the ANOVA on the dependent variable of perceived competence, presented in Table 19, indicate that there is a significant difficulty setting * competition setting interaction, while the main effect of difficulty was not significant and the main effect of competition was significant. The main effect for Difficulty setting yielded an F ratio of $F(1,137) = 2,393$, $p > .05$, indicating that there was no significant difference between Decreasing Difficulty setting ($M = 8729$, $SD = 4322$) and Increasing Difficulty setting ($M= 10393$, $SD=10781$). The main effect for Competition setting yielded an F ratio of $F(1,137) = 5,580$, $p < .05$, indicating that the effect for

Competition was significant for Competition Existing (M = 11066, SD = 8842) and Competition Not Existing (M= 8163, SD=7283). The interaction effect was significant, F(1,137) = 10,118, p< .05. Posthoc tests found a significant effect of difficulty setting in the cases of competition existing F(1,67)=9,265, p<.05 and not a significant effect in the absence of competition F(1,67)=1.623 p>.05.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1025607354,184[a]	3	341869118,061	5,641	,001
Intercept	13315231069,357	1	13315231069,357	219,689	,000
Difficuty	145012934,339	1	145012934,339	2,393	,124
Competition	338222631,625	1	338222631,625	5,580	,020
Difficulty*Competition	613223810,891	1	613223810,891	10,118	,002
Error	8303504304,767	137	60609520,473		
Total	22170143832,000	141			
Corrected Total	9329111658,950	140			

Table 19: ANOVA tests of between subjects effects on variances on performance in the gamified task

The aforementioned results support Hypothesis 5, where it was proposed that in a Gamified Service, in the presence (absence) of competition and social comparison, increased (decreased) difficulty will lead to higher performance in the gamified tasks of the service. As illustrated in Figure 23, subjects who participated in the gamified architecture that employed a leaderboard as means to showcase competition, performed better at the gamified task when it was complemented by an increasing difficulty in progression towards the goal to raise points, rather than a decreasing difficulty. The exact opposite stands for the case of the gamification design that lacked a competitive setting and the player was unaware of the existence of other

players. In that version of the app, the subjects performed better in the gamified activity when the difficulty setting was decreasing as opposed to increasing.

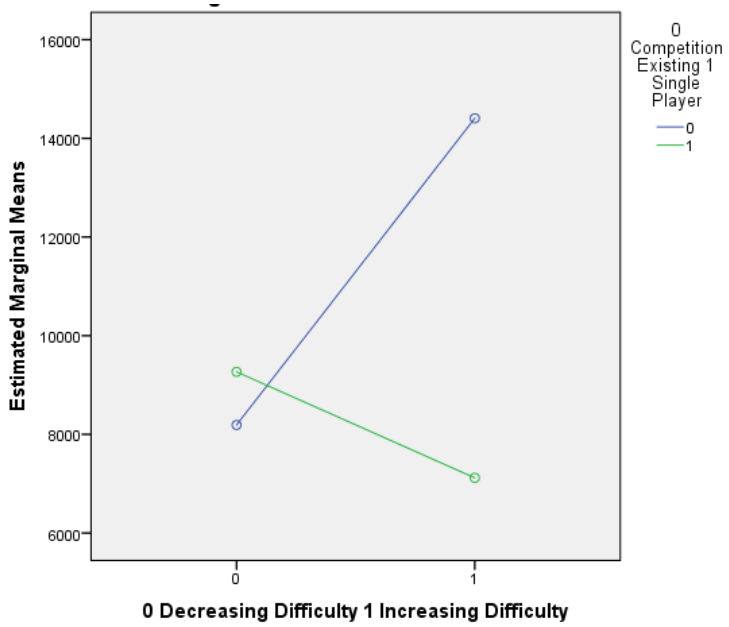


Figure 23: Estimated Marginal Means of Performance in Points

6.4.3 Effects of Gamification Design on Perceived Competence

As the game elements introduced in the experiment cater to the development of Perceived Competence mainly, a two-way between subjects analysis of variance (ANOVA) was conducted to test for the effect the different gamification design had on the perceived competence each participant each participant had while engaging with the gamified task. The descriptive statistics are summarized in Table 20, and the results from the Levene's test for homogeneity illustrate a significance level of .187 (>0.05).

Difficulty Setting	Competition Setting	Mean	Std. Deviation	N
Decreasing	Competition Yes	4,6019	,85753	36
	Competition No	5,0741	,86597	36
	Total	4,8380	,88809	72
Increasing	Competition Yes	4,8495	,90611	31
	Competition No	4,7018	,65204	38
	Total	4,7681	,77397	69
Total	Competition Yes	4,7164	,88240	67
	Competition No	4,8829	,78112	74
	Total	4,8038	,83197	141

Table 20. Descriptive statistics for perceived competence under the different gamification design

The results of the ANOVA on the dependent variable of perceived competence, presented in Table 21, indicate that there is a significant difficulty setting * competition setting interaction, while neither the main effect of difficulty nor the main effect of competition was significant. In particular Difficulty setting consisted of two levels (Increasing and Decreasing) and Competition setting consisted of two levels (Competition Available and Competition Not Available. The main effect for Difficulty setting yielded an F ratio of $F(1,137) = .202$, $p > .05$, indicating that there was no significant difference between Decreasing Difficulty setting ($M = 4,84$, $SD = .89$) and Increasing Difficulty setting ($M= 4,77$, $SD=.77$). The main effect for Competition setting yielded an F ratio of $F(1,137) = 1.369$, $p > .05$, indicating that the effect for Competition was not significant for Competition Existing ($M = 4,72$, $SD = .88$) and Competition Not Existing ($M= 4,88$, $SD=.78$). The interaction effect was significant, $F(1,137) = 4.996$, $p< .05$. Posthoc tests did not find a significant effect of difficulty setting in the cases of competition existing $F(1,67)=1.318$, $p>.05$ but a significant effect in the absence of competition $F(1,67)=4.395$ $p<.05$.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4,558[a]	3	1,519	2,254	,085
Intercept	3239,156	1	3239,156	4805,434	,000
Difficulty	,136	1	,136	,202	,654
Competition	,923	1	,923	1,369	,244
Difficulty * Competition	3,367	1	3,367	4,996	,027
Error	92,346	137	,674		
Total	3350,667	141			
Corrected Total	96,905	140			

Table 21: ANOVA tests of between subjects effects on variances on perceived competence in the gamified task

The aforementioned results support Hypothesis 3, where it was proposed that in a Gamified Service, in the presence (absence) of competition and social comparison, increased (decreased) difficulty will lead to higher perceptions of competence in the gamified tasks of the service. As illustrated in Figure 24, subjects who participated in the gamified architecture that employed a leaderboard as means to showcase competition, perceived themselves to become more competent with the gamified task when it was complemented by an increasing difficulty in progression towards the goal to raise points, rather than a decreasing difficulty. The exact opposite stands for the case of the gamification design that lacked a competitive setting and the player was unaware of the existence of other players. In that version of the app, the subjects perceived themselves to be more competent when the difficulty setting was decreasing as opposed to increasing.

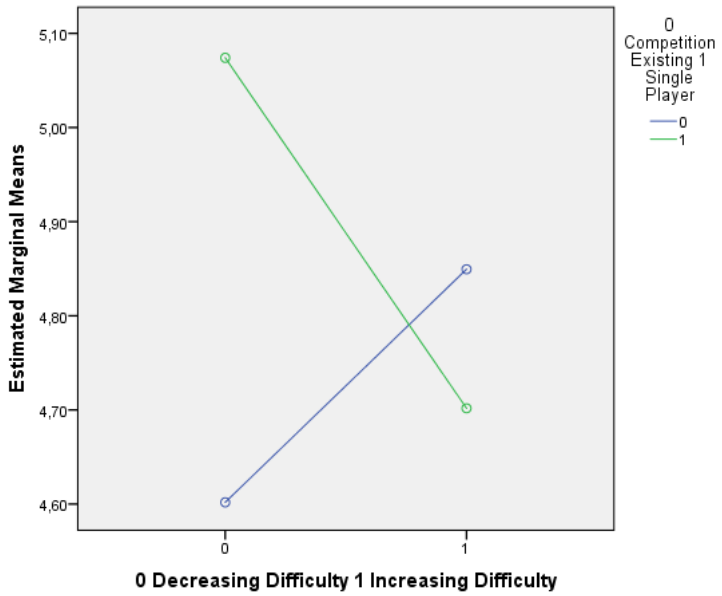


Figure 24: Estimated Marginal Means of Performance (in Points)

6.4.4 Moderated Mediation in the relationship between gamification design, psychological outcomes and behavioural outcomes

To examine for the underlying mechanism of the effect the game elements related to the behavioural outcomes through the psychological outcomes (perceived competence) and their relationship, we tested for moderated mediation, as outlined by Hayes (2013) using the PROCESS macro. Specifically we tested to see whether perceived competence mediates the relationship between gamification design and behavioural outcome of performance, whilst competition setting mediated the effect of perceived competence relative to the difficulty setting (this model corresponds to Model 7 in Hayes, 2013) as illustrated in Figures 25 and 26 for the behavioural outcomes of performance in the gamified activity and engagement with the gamified electronic service.

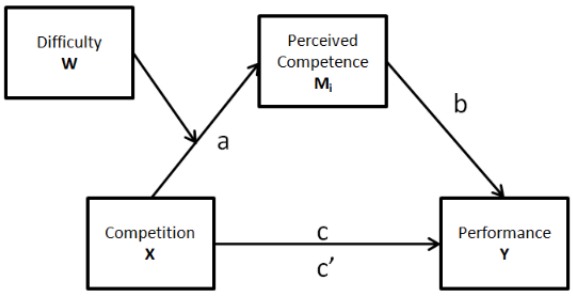


Figure 25: Moderated mediation on Performance

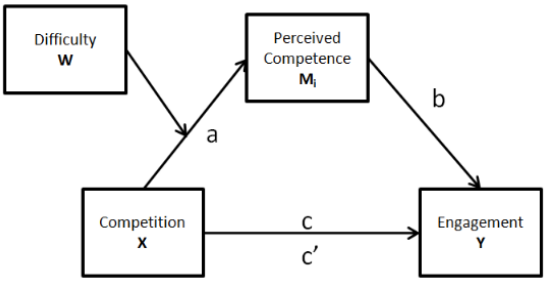
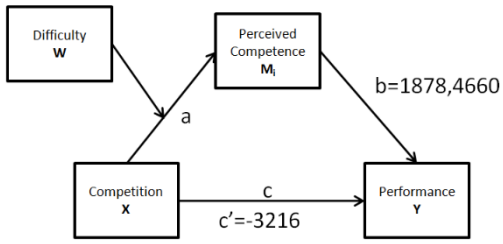
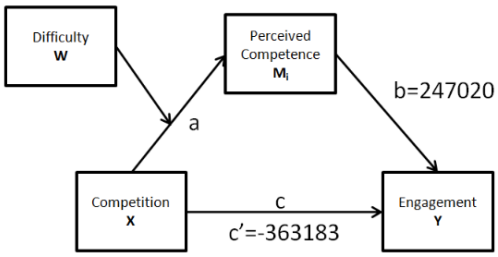


Figure 26: Moderated mediation on Engagement

Pertaining to the behavioural outcomes of performance and engagement in the gamified activity in terms of points and ms respectively and using the entire sample, we ran the mediation analysis suggested by Hayes (2013; PROCESS model 7) to estimate mediated moderation for two way interactions. We entered Competence perceptions as mediators in the model. Pertaining to the behavioural outcome of performance in the gamified service, the results of a bias-corrected (BC) bootstrapping analysis based on 5000 bootstraps revealed that perceptions of competence mediated the effect of difficulty on the outcome of points under the existence of competition (95% BC bootstrap confidence interval [CI], 78,1489 to 2658,5418) but not under the absence of competition and single play (95% BC bootstrap confidence interval [CI], -1547,4596 to 288,4013). A similar result was found related to the engagement with the gamified electronic service where the results of a bias-corrected (BC) bootstrapping analysis based on 5000 bootstraps revealed that perceptions of competence mediated the effect of difficulty on the outcome of points under the existence of competition (95% BC bootstrap confidence interval [CI], 2864,2262 to 355786,595) but not under the absence of competition and single play (95%

BC bootstrap confidence interval [CI], -99146,39 to 40312,6372). The results of the mediated moderation analysis are found in Table 22.

<table>
<tr>
<td> 
</td>
<td> 
</td>
</tr>
<tr>
<td colspan="2">X->M t(137) =33.63, p<.05
W->M t(137) = 1.23, p>.05
Interaction t(137) =.277, p<.05</td>
</tr>
<tr>
<td>C1 (Low) b= 887
C1 (High) b = -277
b t(138) = 2.31, p< .05
C' t(138)= -2.39, p<.05

INDEX OF MODERATED MEDIATION
BootLLCI = - 3586,8232 to BootULCI = - 52,063
SE=853,9420</td>
<td>C1 (Low) b= 116648
C1 (High) b = -36486
b t(138) = 2.05, p< .05
C' t(138)= -1.82, p>.05

INDEX OF MODERATED MEDIATION
BootLLCI = - 488075.72 to BootULCI = - 3912,0112
SE=117714.285</td>
</tr>
</table>

Table 22: Moderated mediation results (PROCESS Model 7)

The aforementioned results support Hypothesis 6, where it was proposed that in a Gamified Service perceived competence will mediate the effect of gamification design to the behavioural outcomes of the end –users.

Pertaining to the ecological conscious consumption variable, that controlled for the factors related to the specific non-game context, the two way ANOVA test showed that there was no statistically significant difference between the groups (F-1.877, p=.136) of participants during the random placement in groups, something that could have potentially affected the results. Additionally an in terms of the experienced autonomy during the interaction with the gamified

service the two way ANOVA test showed that there was no statistically significant difference between the four groups (F=.014, p=.908) . Furthermore it was found that difficulty and competition did not affect perceptions of Intrinsic motivation in a statistically significant manner (F=1.295, p=.257). Lastly, in terms of the demographic control variables of age, sex and educational level, no significant difference was found between the groups.

6.5 Discussion

This study aims to stress the importance of selecting the appropriate combination of game elements during the design of a gamified system. Though an experimental design, it has demonstrated that different game elements have significantly different impact on user behavioural and psychological outcomes when employed in the appropriate combination.

Results indicate that the game element of progression difficulty (Plateau or Reverse), and respectively the game element of leaderboard (signifying existence of competition), did not have a significant effect on players' behavioural and psychological outcomes on their own. However, when combined they presented significantly different results. In particular in the presence of a leaderboard, increasing difficulty led to a significantly higher engagement with the experimental application (POOLL) of the designed and developed gamified electronic service. The case as hypothesized in H4 and H5 that were supported, is that as the game progresses and becomes more difficult, as expected, the presence of competition towards the same goals, creates a more compelling game setting, where the effect of performing well is directly visible through the leaderboard. This visualization of player's competence in parallel to others' performance, creates a motive to continue engaging with the gamified application to become better than the remaining players and/or not lose ranking from the participants that are right below her/him. This is

consistent with the basic need satisfaction of perceived competence in Self Determination Theory. On the other hand, in the absence of a leaderboard, and lack of this direct comparison, decreasing difficulty in levels showed statistically significant higher engagement and performance. The case for the present scenario can be that the perceptions of the player's own competence in the gamified application are illustrated through her/his own better performance as the game progresses. And as the game became easier progressively, the player felt that (s)he was becoming more skilled in the gamified tasks of the service. In both cases, the selected game elements played a different role in engaging the user in the gamified activity and it was through their combination that a statistically significant result was achieved. In the case that one of two was introduced without experimentation in the gamified architecture of the final smartphone application, the expected overall engagement would have been different. Overall, in the case of the non-gamified context of raising environmental awareness through a gamified electronic service employing a smartphone application as touch point, results indicate that besides the base element of points, necessary in all gamified architectures, a leaderboard and higher difficulty progression can have a significant higher engagement and performance effect.

Additionally to the behavioural outcomes of gamification this study aimed to uncover the psychological outcomes and the role it played in the behavioural outcomes of the gamified electronic service. It was hypothesized that in parallel with Self Determination Theory, perceptions of higher competence in the gamified activity will lead to higher behavioural outcomes. Through statistical mediation analysis the results indicated that perceived competence partially mediate the effect of gamification design to the behavioural outcomes of the end –users. In particular it was found that the effect of difficulty on the outcomes of performance and engagement was mediated by perceived competence under the existence of competition but not

under the absence of competition and single play. This was an interesting finding as in the absence of competition and with difficulty alone perceptions of competence were not found to affect the outcomes singlehandedly.

Another important finding that stems from the results of this study adheres to the design process of the gamified electronic service. Besides the specific game-elements that were examined and the game elements that have been (and will be examined) by gamification researchers, in the case of uncertainty in the design phase, and based on user requirements, experimentation can support the overall process. Conducting either laboratory or field experiments in the process of developing a gamified electronic service can serve as means for the system designers to make informed decisions about critical design choices. Traditionally in the process of design and development, user requirements guide the designers to create an architecture that meets the identified requirements. However, specific decisions made during the design phase will have an important effect on the final outcome in terms of engagement with the service, or adoption of the solution and even overall success of the project. For gamified systems, such decisions pertain to the overall gamification architecture and selection of the appropriate game elements. In order to make informed decisions, especially in the case of fuzzy requirements or inexistence of previous best practices, rapid cycles of experimentation with users early on in the process can offer validation and increase the rate of success.

Lastly and in terms of the experimentation medium, the developed electronic service and smartphone application that supported the research of this study can serve as a starting point for a wider gamification experimentation movement where all game elements are examined in pairs (or more) for their combined effects under different gamification architectures. Lastly, as the infrastructure enables the representation of the non-game context in terms of app content,

separate from the gamification architecture, it is a “white-label” context agnostic gamification experimentation app capable to address different non-game contexts, relevant to each researcher’s field.

Chapter 7: Research Contribution and Conclusions

7.1 Research Overview

The introduction of gamification the past years in the industry has been profound and the need to identify the possibilities of gamification to motivate participants to engage and perform in the context of a gamified service was the main motivation of this research. Existing research on gamified services stems from the information systems and marketing literature. The main focus of current research efforts has been focusing on the identification of benefits of gamification applied on different non-game contexts and under varying gamification designs. However little work is extant on the effect of different game elements on the goals of gamification as little research has examined individual game elements in isolation. Furthermore current research has not taken the next step to identify the effect of combined game elements in isolation and their effect on the goal of the gamification process. This doctoral thesis aims to fill that gap and propose a research agenda where different game elements are examined in combination for their effect in a gamified mobile service.

This thesis was based on two exploratory studies and two empirical studies. Firstly, the exploratory phase was conducted to identify the game elements that were prominent to motivate participants when utilized in combination and presented potential towards engagement and performance in the non-game context at hand. Further on through the set of focus groups, the non-game context was examined to identify its intricacies and potential to be gamified as well as the combinations of the game elements that would be included in the gamified application. The outcome of these studies was the gamification design that was later examined as the exemplar gamification application design in the empirical studies. The first empirical study examined the

effect of two game elements on motivation to participate in the gamified service, in a laboratory experiment, with the use of a fully functional interactive mockup of the to-be developed gamified application. Results from the first study indicated that the reward setting did not have an effect on their perceived intrinsic motivation – enjoyment whereas participating in a team collaborative gameplay mode had a higher potential to motivate. The results motivated the second study where two game elements were examined in combination with the purpose to investigate the direct effect of the gamified service design through the developed application, on participants behaviour and performance in the non-game context, by taking into account the moderating effect of perceived competence and the mediating effects of the game elements.

7.2 Research Contribution

This doctoral research contributes to the existing body of knowledge of different disciplines that are directly related to gamification of electronic services and their impact on participant behaviour and motivation. The results of this research have implications for researchers and scholars examining the design of gamified services and how users can be motivated during participation to engage with the respective non-game context. The theoretical implications of this research are summarized below:

7.2.1 Theoretical Implications

7.2.1.1 Design of gamified electronic services

In the process of designing a gamified electronic service as its aim is to motivate end-users to conduct activities and tasks in non-game contexts, this doctoral thesis accentuates the importance of the careful selection of game elements during the gamification design phase. In

order for the selection of game elements, to be successful, the introduction of the end-users in the design process is proposed as a method to assist in the process of the selection of the most prominent game elements to complement the activities to be gamified in the offered electronic service. The introduction of the end-user in the initial selection of game elements enables the gamification designer to select the initial pool of game elements eligible for introduction taking under consideration, the business driven goals of the gamified service, the intricacies of the non-game context as well as the end-user perspective. Subsequently via iterative rounds of experimentation with different combinations of game elements via laboratory experiments and/or field experiments, an initial validation of the design choices can be conducted in order to fine tune the gamification design prior to deployment.

Another contribution of this doctoral thesis pertains to the overall process of designing a gamified electronic service. In the latter years, a number of gamification frameworks have been proposed in order to support the process of gamifying activities and tasks, which currently lack validation (Deterding, 2017). This doctoral research utilizes the Mechanics Dynamics Aesthetics framework on game design and through a series of iterative stages in the design, proposes the application of different setups of the MDA in the process of identifying the most prominent gamification design, as perceived by the end users. Additionally and pertaining to the process of designing a gamified electronic service, this doctoral research proposes as set of sequential and iterative stages in the design process. In the first phases of the gamification design, the goals of the gamified electronic service are developed alongside with the identification of the intricacies of the non-game context. Subsequently, the literature is surveyed as well as industry best practices to account for game elements eligible for introduction based on extant work. Following that a series of requirements elicitation is conducted bringing in selected end-users in the

process. Following that, the initial gamification design(s) is(are) proposed and iterative rounds of user research are conducted in order to identify in a controlled experiment the potential for the gamification design(s) to support the goals of the gamified service. Having an initial validation of the design choices on the game elements an initial development and a second round of experimentation(s) can take place in order to examine the overall gamified services' effect.

7.2.1.2 Examines game elements in isolation and combination under gamification designs.

Previous results have mainly focused on the examination of gamification designs and application on non-game contexts as an overall system, not being able to distinguish the effect each game element had on the outcomes of the study. The aforementioned was identified by several researchers (Seaborn and Fels., 2015; Deterding, 2015) that proposed further research towards that direction. Additionally, a limited number of studies aimed to address, the effects of game elements in isolation with most prominent being badges, Levels and Leaderboards. Although research in the latter years progresses towards examining individual game elements to the best of the author's knowledge this is the first research to identify the need for combined game elements examination and empirically examines two game elements in combination have the potential to drive behavioural and psychological outcomes differently than game elements in isolation. This doctoral research examined the effects of Rewards, Difficulty progression and Gameplay mode (single player or team collaborative) building on the extant knowledge of game elements' application in gamified electronic services.

7.2.1.3 Empirically investigates behavioural and psychological outcomes of gamification

This doctoral research examines different game elements in gamification designs and their effect on behavioural and psychological outcomes of gamification. In particular it examines the effect of different game elements on end-users engagement with the gamified electronic service utilizing analysis of log-based interactions in a field experiment. Additionally and in terms of the psychological outcomes of gamification the research examines the effects of different game elements on perceived enjoyment during participation in the gamified service as well as intrinsic motivation to conduct the gamified activity utilizing the principles of Self Determination Theory. This contribution is inline with the identified need to examine gamification under the lens of motivational theories for its capacity to motivate the end users in conducting tasks and activities (Seaborn and Fels, 2015, Hamari, 2014).

In terms of behavioural outcomes of gamification results from the field experiment show that the combination of two game elements can present a significant interaction effect in terms of the overall engagement with the gamified electronic service as well as in end-users performance in the gamified task. In particular it was found that in the when a leaderboard is extant, increasing difficulty (PLATEU) led to higher engagement and performance where in the absence of a leaderboard decreasing difficulty (REVERSE) had the same effect. This finding presents an important direction towards future research where game elements are paired and examined for their combined effect on the goals of gamification.

In terms of psychological outcomes of gamification, results from the laboratory experiment indicate that the utilization of team collaboration capabilities towards the pursuit of a reward lead to higher perceived enjoyment opposed to a single type pursuit of a reward. Further on, intrinsic oriented rewards and extrinsic oriented rewards were not found to have a significant

impact on perceived enjoyment leading to identifying for the need of a stream of research pertaining to the gamification of loyalty programs that when viewed under the gamification lens are gamified electronic services build based on Redeemable points and Extrinsic rewards. Additionally, the field experiments results indicate the capacity of paired of game elements to effect differently the basic psychological needs of end-users. In particular and based on Self Determination Theory, the two game elements of leaderboards and difficulty were found to effect in combination the perceptions of competence of the end-users, adding to the body of knowledge of gamification.

7.2.1.4 Examines the mediating effect of the psychological outcomes to the behavioural outcomes

In terms of the underlying process that enables the motivational power of gamification, when gamification is examined under the lens of Self Determination Theory, this doctoral research adds to the body of knowledge in terms that it identifies that game elements can have an effect on the behavioural outcomes through enabling the psychological outcomes of end users. In SDT the basic needs include the need for competence, autonomy and relatedness in order to support feeling of intrinsic motivation to conduct a task. In particular on perceived competence it was found that game elements in combination can have an effect on supporting the feelings of perceived competence of end users as means to lead to higher engagement and performance.

7.2.1.5 Applies gamification on the non-game context of environmental awareness

Out of a plethora of non-game contexts eligible for introduction of gamified electronic services this doctoral thesis examines the non-game context of environmental awareness and sustainable consumption. The results of the studies indicate that it is a prominent non-game

context for gamification as game elements were found to affect the outcomes of the service in a significantly different way leading to higher engagement with the non-game context's service. Further on, the results of the focus group enabled the identification of the dichotomization of the non-game context to the gamified service in terms that it was found that the non-game context should pertain to the content of the service and the operationalization of the mechanics (i.e. badge design) rather than the dynamics of the gamification design.

7.2.1.6 Methodological Innovations

This doctoral research presents two methodological innovations that can motivate future research efforts in the field. Initially the utilization of end-users in the design process in the interviews and focus groups exploits the methodology of "lead users" in the gamification service design process which is according to recent calls for consumer involvement in technology-dased service design. Further on it utilizes non-game context specific instruments (ECCB) to further segment the outputs of the end-users towards understanding for the non-game context specific intricacies. Moreover it uses a laboratory experiment in the early stages of the design to validate the design decisions based on formal research methods as well as a field experiment to examine for the game elements effects in a real world setting.

7.2.2 Managerial Implications

The results of this dissertation provide a number of impactful implications for gamification designers and companies interesting in introducing gamification in their offering towards supporting their customers' and end-users' non-game context. Results from the two empirical studies have shown that the gamification design selected for implementation affects the behavioural and

psychological outcomes of end-users, relative to the game elements introduced in the gamified electronic service.

Managers through the appropriate design can utilize different game elements under gamification designs in order to manipulate and satisfy the needs of competence, autonomy and relatedness of the end-users towards enabling feelings of intrinsic motivation to conduct the tasks of the gamified electronic service. In order to achieve that, in the process of designing a gamified electronic service the end-users should be brought in different phases so as to identify the results of game elements that present potential to enable that manipulation. Currently, a number of Gamification as a Service enterprises offer plug and play gamification solutions, where a plethora of game elements is available for introduction, however the design of gamification is not covered. This doctoral research accentuated the fact that one-size-fits-all solutions can be problematic calling managers to pay attention in the process of utilizing the aforementioned solutions. In particular, combining leaderboards and difficulty, leads to different results, under different conditions of each game element. In the process of gamifying their electronic service, managers can conduct a series of formal research studies to identify and tailor the gamification design prior to development and deployment.

Another managerial implication of this research stems from the creation of the POOLL gamified electronic service on its own as a medium that enables the context agnostic experimentation. The POOLL infrastructure and smartphone application enables the deployment of game elements in different experimental designs. For the purposes of this doctoral research two game elements were manipulated, however the service is able to introduce and manipulate different (or additional) game elements towards creating different experimental conditions. Additionally the POOLL user management enables the execution of both within and between experimental designs relevant to the needs of each research. Lastly as the non-game context is represented in the content of the application, the managers can formulate and introduce their respective content as means to cater

to their industry's non-game context. The POOLL service is scheduled to be available as an open source software package to enable the examination of different game elements in non-game contexts.

7.3 Limitations and Future Research

This study has also several limitations that present opportunities for future research avenues. This sections presents the limitations of this study as well as the planned and ongoing research directions in the field of gamification of electronic services in the following paragraphs.

7.3.1 Future research related to methodology

A possible limitation of this research is related to the methods used to design the gamified electronic service and to select the game elements. We used interviews and focus groups to select the most prominent game elements to be introduced in the gamified service. One may argue that a survey of the potential end-users would enable the reception of the perceptions on game elements from a wider audience. However, considering the lack of evidence in the literature pertaining to game elements, the qualitative nature of the interviews and focus groups enabled the research to deepen into each game element examined.

Another methodological limitation adheres to the utilization of a gamified application (POOLL) as a tool for a field experiment and the manipulation of the gamification design. One may argue that the degrees of familiarity with smartphone application or the UI features of the application could have an effect on the overall engagement with the gamified service. A future research direction includes the redesign of the UI of the application as current best practices dictate as well as the examination of the effect of UI choices as well as of the technological infrastructure's load capacity and response time effect on engagement and performance.

Lastly a limitation pertaining to the measurement issues is the small number of indicators used for each construct. However the satisfactory levels of measurement validity and internal consistency alleviate this limitation as well as to avoid respondents' fatigue.

7.3.2 Future research related to game elements

This doctoral research examined three game elements in different operationalizations. However in the gamification literature a number of game elements are extant that remain unexplored. Therefore a prominent research opportunity adheres to the utilization of the developed gamified electronic service as a medium to examine different game elements in isolation and in pairs leading up to full fledged gamification designs incorporating various game elements. The results of this stream of future research will shed light on the importance of identifying the most prominent combinations of game elements, towards enabling psychological and behavioural outcomes of gamified services. As this endeavor is vast, in order to enable the current gamification researchers as well as inspire the upcoming generation of researchers in the field, the POOLL service and infrastructure will be made available as an open source solution for game element and gamification experimentation.

7.3.3 Future research related to end-users

Having focused on the effect of combining game elements under different gamification designs in an electronic step, future research directs the identification of the relation of the end-users predispositions relative to the gamification design decisions as well as the non-game contexts' intricacies. In particular the examination of the different types of players in relation to the game elements presents an interesting research direction which is currently ongoing utilizing two different European Funded research projects. The attitudes and intentions of the players

relative to their player type is examined as antecedents for the effect they have on the goals of the gamification design, with initial results (Kotsopoulos et al.,2017) indicating that different personality types prefer different game elements to be extant in a gamified electronic service as means to motivate them to engage with it and perform in its gamified tasks.

7.3.4 Extension to other non-game contexts

This doctoral research examined the non-game context of environmental awareness and environmentally conscious consumption in the field of FMCG, which presents a limitation. As gamification is currently introduced in various non-game contexts such as education, marketing, employee productivity and health among others future research agendas dictate the examination of gamification in the respective non-game contexts. Currently research is conducted in the non-game context of energy efficiency in the workplace with the goal to motivate employees to adopt an energy efficient lifestyle (Lounis et al., 2017).

REFERENCES

Antin and Churchill (2011) “Badges in Social media A Social Psychological Perspective.” *CHI 2011*, May 7-12, 2011 Vancoucer, Canada

Aparicio, A.F.,Vela,F.L.G.,Sánchez,J.L.G.,Montes,J.L.I. (2012) “Analysis and application of gamification” . In: Proceedings of the *13th International Conference on Interacción Persona-Ordenador. INTERACCION'12* , ACM, Elche, Spain, p.17.

Avedon, E., and Sutton-Smith, B. (1971) The Study of Games. John Wiley & Sons, New York, NY, 1971

Barata, G., Gama, S., Jorge, J. and Daniel G. (2013) “Improving participation and learning with gamification”. In *Proceedings of the First International Conference on Gameful Design, Research, and Applications* (Gamification '13). ACM, New York, NY, USA, 10-17. DOI=http://dx.doi.org/10.1145/2583008.2583010

Barnes, D.E., Yaffe, K., Belfor, N., Jagust, W.J., DeCarli, C., Reed, B.R., Kramer, J.H. (2009) “Computer-based cognitive training for mild cognitive impairment: results from a pilot randomized, controlled trial” *Alzheimer Dis. Assoc. Disord*. 23 205–210, http://dx.doi.org/10.1097/wad.0b013e31819c6137.

Barthel, M. L. (2013). “President for a day: video games as youth civic education.” *Inform. Commun. Soc.* 16, 28–42. doi: 10.1080/1369118X.2011.627176

Berengueres, J., Alsuwairi, F., Zaki, N., Ng, T., (2013). “Gamification of a recycle bin with emoticons.” In: Kuzuoka, H., Evers, V., Imai, M., Forlizzi, J. (Eds.), *Proceedings of the 8th ACM/IEEE International Conference on Human–Robot Interaction.* Presented at HRI 2013. IEEE, New York, pp. 83–84.

Bhattacherjee, A. (2012), *Social Science Research: Principles, Methods, and Practices*, Tampa, FL: CreateSpace.

Bjork, S. and Holopainen J. (2004). Patterns in Game Design (Game development series), MA: Charles River Media, ISBN 1584503548.

Blohm, I., Leimeister, J.M., (2013). “Gamification: Design of IT-based enhancing services for motivational support and behavioral change.” *Business and Information Systems Engineering*, Vol 5, Issue 4, pp 275–278.

Bobbitt, L. M. and P. A. Dabholkar (2001), "Integrating attitudinal theories to understand and predict use of technology-based self-service," *International Journal of Service Industry Management*, 12 (5), 423-50.

Broeck Van Den, A., Vansteenkiste, M., Witte, H., Soenens, B., & Lens, W. (2010). “Capturing autonomy, competence, and relatedness at work: Construction and initial validation of the Work-related Basic Need Satisfaction scale.” *Journal of Occupational and Organizational Psychology*, 83(4), 981e1002. http://dx.doi.org/10.1348/096317909x481382.

Budd, R. W., Thorp, R. K., & Donohew, L. (1967). *Content analysis of communications*. New York: Macmillan.

Burke, M and Hiltbrand, T. (2011). :How gamification will change business intelligence." *Business Intelligence Journal*, Volume 16 (2), pp8-16.

Butler, C. (2013). "The Effect of Leaderboard Ranking on Players' Perception of Gaming Fun." In *Ozok A.A. and Zaphiris P.(Eds.): OCSC/HCII 2013*, LNCS 8029 pp 129-136

Caillois, R., & Barash, M. (1961) Man, Play, and Games. New York

Catterall, M. and Maclaren, P. (2007), "Focus Groups in Marketing Research," in *Handbook of Qualitative Research Methods in Marketing*, R. W. Belk, ed., Edward Elgar Publishing, 255–67.

Cerasoli, C. P., Nicklin, J. M., & Ford, M. T. (2014). "Intrinsic motivation and extrinsic incentives jointly predict performance: a 40-year meta-analysis." *Psychological Bulletin*, Volume 140 p 908-1008

Cheong, C., Cheong, F., Filippou, J. (2013) "Quick Quiz: A Gamified Approach for Enhancing Learning". In Proceedings of *PACIS 2013*, June 18-22 , Korea. Paper 206

Chou, Y., (2012) "Octalysis: Complete Gamification Framework" http://www.yukaichou.com/gamification-examples/octalysis-complete-gamification-framework/

Coffey, A., & Atkinson, P. (1996). "Making sense of qualitative data: Complementary research strategies". Thousand Oaks: Sage.

Cramer, H., Rost, M., Holmquist, L.E., (2011). "Performing a check-in: emerging practices, norms and "conflicts" in location-sharing using foursquare." In: *Proceedings of the 13th International Conference on Human–Computer Interaction with Mobile Devices and Services*. Presented at MobileHCI'11. ACM, pp. 57–66

Creswell, J. W (2003), "Research Design: Quantitative and Qualitative and Mixed Method Approaches". Thousand Oaks, CA: Sage.

---- (2013), "Research design: Qualitative, Quantitative and Mixed Methods Approaches", Thousand Oaks, California: SAGE Publications, Inc. ISBN 1452226105

---- (2014), "Research design: Qualitative, Quantitative and Mixed Methods Approaches", Thousand Oaks, California: SAGE Publications, Inc.

Cronbach, L. J. (1951). "Coefficient alpha and the internal structure of tests". *Psychometrika* (16), pp. 297-334

Crotty, M. (1998) "The foundatitions of social research. Meaning and Perspective in the Research Process". *SAGE Publications* Ltd ISBN: 9780761961062

Csikszentmihalyi, M. (1991): "Flow: The psychology of optimal experience." 1st Harper Perennial pbk. ed. New York, N.Y: Harper Perennial.

Dabholkar,P. A. and Bagozzi, R.R. (2002). "An Attitudinal Model of Technology –Based Self Service: Moderating Effects of Consumer Traits and Situational Factors". *Journal of the Academy of Marketing Science*, 30 (3), pp. 184-201

Dale, S. (2014) "Gamification: Making work fun, or making fun of work." *Business Information Review*. July 2014, Vol 31(2) pp 82-90

Darejeh, A., Salim., S.S (2016) “Gamification Solutions to Enhance Software User Engagement – A systematic review”. *International Journal of Human-Computer Interaction.* Vol.32 Issue 8 pp 613-642

Davis, F.D., Bagozzi, R.P. and Warshaw, P.R. (1989), "User Acceptance of Computer Technology : a comparison of two theoretical models," *Management Science*, 35 (8), 982-1003.

Davis, K., Singh, S. (2015). “Digital Badges in afterschool learning: Documenting the perspectives and experiences of students and educators.” *Computers & Education*. Volume 88, 2015, pp. 72-83

De Charms, R. (1968). “Personal Causation: The internal effective determinants of behavior”, NewYork: Academy Press.

De Paoli, S., De Uffici, N., D'Andrea, V. (2012). “Designing Badges for a Civic Media Platform: Reputation and Named Levels.” *In Proceedings of the 26th Human Computer Interaction (HCI 2012)* Conference, Birmingham, UK.

De Rocha Seixas, L., Gomes, A.S., de Melo Filho, J. (2016) “Effectiveness of gamification in the engagement of students”. *Computers in Human Behavior*, Volume 58, May 2016, pp 48-63

Deci, E. L., & Ryan, R. M. (2000). “The "what" and "why" of goal Pursuits: Human needs and the self-determination of behavior”. *Psychological Inquiry*, 11(4), pp 227-268.

Deci, E. L., & Vansteenkiste, M. (2004). “Self-determination theory and basic need satisfaction: Understanding human development in positive psychology.” Ricerche di Psicologia Vol 27(1) pp 23-40

Deci, E. L., & Ryan, R. M. (2012). “Motivation, personality, and development within embedded social contexts: An overview of self-determination theory.” In R. M. Ryan (Ed.), *The oxford handbook of human motivation* (pp. 1-59). Oxford: Oxford University Press. http://dx.doi.org/10.1093/oxfordhb/9780195399820.013.0006.

Deci, E. L., Eghrari, H., Patrick, B. C., & Leone, D. (1994). “Facilitating internalization: The self determination theory perspective.” *Journal of Personality*, 62, 119-142.

Denny, P. (2013) “The effect of virtual achievements on student engagement.” In proceedings of the *CHI 2013: Changing Perspectives Conference*. April 27-May 2, 2013, Paris, France

Deterding, S. (2015). “The lens of intrinsic skill atoms: A method for gameful design.” *Human-Computer Interaction*, 30(3e4), 294-335. http://dx.doi.org/10.1080/ 07370024.2014.993471

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). “From game design elements to gamefulness: Defining gamification.” In Proceedings of the *15th international Academic MindTrek Conference: Envisioning Future Media Environments* (pp. 9– 15), Tampere, Finland, September 28–30.

Deterding, S., (2011). “Situated motivational affordances of game elements: a conceptual model.” In: *Gamification: Using Game Design Elements in Non-Gaming Contexts, a Workshop at CHI. Presented at CHI 2011.* ACM, Vancouver, BC, pp. 1–4.

DiTommaso, D., (2011) “Beyond gamification: Architecting engagement through game design thinking.” https://www.slideshare.net/DiTommaso/beyond-gamification-architecting-engagement-through-game-design-thinking/ (Accessed January 2013)

Dominguez, A., Saenz-de-Navarrete, J.,de-Marcos, L. Fernandez-Sanz, L., Pages, C., and Martinez-Herraiz, J.-J. (2013) "Gamifying learning experiences: Practical implications and outcomes", *Computers & Education*, 63, 2013, pp. 380–392.

Dong, T., Dontcheva, M., Joseph, D., Karahalios, K., Newman, M., Ackerman, M. (2012). “Discovery-based games for learning software.” *In Proceedings of the SIGCHI conference on human factors in computing systems.* ACM pp. 2083-2086.

Doukidis, I.G., Pramatari, K., Lekakos G. (2008) “OR and the management of electronic services.” *European Journal of Operational Research* 187 pp1296-1309. doi:10.1016/j.ejor.2006.09.014

Downes-Le Guin, T., Baker, R., Mechling, J., Ruyle, E., (2012). “Myths and realities of respondent engagement in online surveys”. *International Journal of Marketing Research*. 54, 613–633. http://dx.doi.org/10.2501/IJMR-54-5-613-633.

Ducheneaut, N., Yee, N., Nickell, E., Moore, R.J. (2006). “”Alone Together?”: Exploring the social dynamics of massively multiplayer online games”. In Proceedings of *CHI 2006 SIGCHI Conference on Human Factors in Computing Systems*, New York, USA, pp. 407-401.

Dunlap, R.E., Mertig, A.G., Jones, R.E. (2000) “Measuring Endorsement of the New Ecological Paradigm: A Revised Nep Scale”. *Journal of Social Issues* 56(3), 425–442

Elverdam C. and Aarseth, E., (2007). “Game Classification and Game Design: Construction Through Critical Analysis.” *Games and Culture*, 2 (1), pp. 3-22

Eisenhardt, K.(1989) “Building Theory from case study research.” *Academy of Management Review* 14(4), 592–611

Epstein, J. and Harackiewicz, J. (1992) “Winning is not enough: The effects of competition and achievement Orientation on Intrinsic Interest” *Personality and Social Psychology Bulletin* (18:2) pp 128-138

Faiers, A., Cook, M., Neame, C. (2007) “Towards a contemporary approach for understanding consumer behaviour in the context of domestic energy use.” *Energy Policy* 35, 4381–43390

Farzan, R., DiMicco, J.M., Millen, D.R., Brownholtz, B., Geyer, W., and Dugan, C. (2008) “When the experiment is over: Deploying an incentive system to all the users”, In *Symposium on Persuasive Technology*, 2008.

Farzan, R., DiMicco, J.M., Millen, D.R., Brownholtz, B., Geyer, W., and Dugan, C, (2008) “Results from deploying a participation incentive mechanism within the enterprise”, In *Proceedings of the twenty-sixth annual SIGCHI conference on Human factors in computing systems*, April 5-10, 2008, Florence, Italy, ACM, pp. 563-572

Farzan, R., Brusilovsky, P. (2011) "Encouraging user participation in a course recommender system: An impact on user behavior", *Computers in Human Behavior*, 27(1), 2011, pp. 276-284

Ferketich, S. (1991). “Focus on psychometrics: Aspects of item analysis.” *Research in Nursing & Health* 14, pp. 165–168.

Fernandes, J., Duarte, D., Ribeiro, C., Farinha, C., Pereira, J.M., da Silva, M.M., (2012). “iThink: a game-based approach towards improving collaboration and participation in requirement elicitation.” *Procedia Computer Science.* Vol 15, pp 66-77 https://doi.org/10.1016/j.procs.2012.10.059

Fitz-Walter, Z., Tjondronegoro, D., Wyeth, P. (2011). “Orientation passport: using gamification to engage university students”. In Proceedings of the 23rd Australian computer-human interaction conference, *OzCHI '11*, pp.122-125

Fishbein, M., and Ajzen, I. (1975). “Belief, Attitude, Intention, and Behavior: An introduction to Theory and Research”, Reading MA: Addison Wesley

Fogg, B. (2009). “A Behavior Model for Persuasive Design”. In Proceedings of the 4th International Conference on Persuasive Technology. Persuasive ’09. ACM.

Foster, J.A., Sheridan, P.K., Irish, R., Frost, G.S., (2012). “Gamification as a strategy for promoting deeper investigation in a reverse engineering activity”. In: Proceedings of the 2012 *American Society for Engineering Education Conference*, pp. AC 2012–AC 5456.

Gadenne, D., Sharma, B., Kerr, D., Smith, T.(2011) “The influence of consumers’ environmental beliefs and attitudes on energy saving behavious.” *Energy Policy* 39, 7684–7694

Gamberini L, Corradi N, Zamboni L, Perotti M, Cadenazzi C, Mandressi S, Jacucci G, Tusa G, Spagnolli A, Bjorkskog C, Salo M, Aman P. (2011) “Saving is fun: Designing a persuasive game for power conservation.” In Proceeding Proceedings of the 8th International Conference on *Advances in Computer Entertainment Technology*, ACE'11. 1-7; 2011.

Gartner, Inc. (2011, November 9). “Gartner predicts over 70 percent of Global 2000 organisations will have at least one gamified application by 2014”. Retrieved from http://www.gartner.com/newsroom/id/1844115

Gartner, Inc. (2012, November 27). “Gartner says by 2014, 80 percent of current gamified applications will fail to meet business objectives primarily due to poor design”. Retrieved from http://www.gartner.com/newsroom/id/2251015

Garcia, F., Pedreira, O., Piattini, M., Cerdeira-Pena, A., Penbad, M. (2017) “A framework for gamification in software engineering.” *The Journal of Systems and Software.* Vol 132 pp 21-40. http://dx.doi.org/10.1016/j.jss.2017.06.021

Gaspar, R., Antunes, D.(2011) “Energy efficiency and appliance purchases in Europe: Consumer profiles and choice determinants”. *Energy Policy* 39, 7335–7346 (2011)

Geen, R.R., Beatty, G.G., Arkin, R.M. (1984). “Human motivation. Physiological, Behavioral, and Social Approaches”. Boston: Allyn and Bacon.

Geelen D, Keyson D, Boess S, Brezet H. (2012) “Exploring the use of a game to stimulate energy saving in households”. *Journal of Design Research* Vol 10 pp102-12

Gnauk, B., Dannecker, L., Hahmann, M., (2012). “Leveraging gamification in demand dispatch systems.” In: Proceedings of the *2012 Joint EDBT/ICDT Workshops*. Presented at EDBT-ICDT'12. ACM, Berlin, Germany, pp. 103–110.

Good, P. I. (2001). “Resampling methods: A practical guide to data analysis (2nd ed.)”. Boston, MA: Birkhauser.

Grant, S. and Betts, B. (2013) "Encouraging User Behaviour with Achievements: An Empirical Study", In *Proceedings of Software on Mining 10th Working Conference the Repositories*, May 18-19, 2013, San Francisco, CA, USA, pp. 65-68.

Gronroos, C. (1998), "Marketing services: the case of a missing product," *Journal of Business & Industrial Marketing* 13 (4/5), 322-338.

Guang Shi, V., Baines, T., Baldwin J., Ridgway K., Petridis P., Bigdeli, A.Z., Urden, V., Andrews, D. (2017). "Using gamification to transform the adoption of servitization” *Industrial Marketing Management* Vol 63 pp 82-91

Guba, E.G. (1990) “The Paradigm Dialog”. SAGE Publications, Inc ISBN: 9780803938236

Gustafsson, A., Katzeff, C., and Bang, M. (2009). “Evaluation of a pervasive game for domestic energy engagement among teenagers”. *ACM Computers in Entertainment* 7, 4, Article 54 (December 2009), 19 pages.

Gustafsson, A. and Bang, M. (2008) “Evaluation of a pervasive game for domestic energy engagement among teenagers”, In Proceedings of the *2008 International Conference on Advances in Computer Entertainment Technology*, December, 2008, Yokohama, Japan, ACM, pp. 232-239

Hakulinen, L., Auvinen, T., & Korhonen, A. (2013). “Empirical study on the effect of achievement badges in TRAKLA2 online learning environment.” In *Learning and teaching in computing and engineering (LaTiCE)* (pp. 47–54). Macau, March 21– 14, 2013. IEEE.

Hamari, J.(2013) “Transforming Homo Economicus into Homo Ludens: A Field Experiment on Gamification in a Utilitarian Peer-To-Peer Trading Service”, *Electronic Commerce Research and Applications*, 12(4), 2013, pp. 236- 245.

--- (2017). “Do badges increase user activity? A field experiment on the effects of gamification”. *Computers in Human Behavior* Volume 71, p469-478 https://doi.org/10.1016/j.chb.2015.03.036

Hamari, J., and Jarvinen, A. (2011). “Building Customer Relationship through Game Mechanics in Social Games.” In M. Cruz-Cunha, V. Varvalho, & P. Tavares (Eds.) Business, Technological, and Social Dimensions of Computer Games: Multidisciplinary Developments, pp. 348-365. Hershey, PA

Hamari, J., Koivisto, J., (2013) “Social motivations to use gamification: An empirical study on gamifying exercise.” In Proceedings of the 21st European Conference on Information Systems ECIS 2013

Hamari, J, Koivisto, J., Sarsa, H. (2014) “Does Gamification Work? - A Literature Review of Empirical Studies on Gamification.” In proceedings of the 47th Hawaii International Conference on System Science. DOI 10.1109/HICSS.2014.377

Hanus, M.D., Fox, J. (2015) “Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort and academic performance”. *Computers & Education.* Volume 80, 2015, pp 152-161

Hartmann, P., Apaolaza-Ibanez, V.(2012) “Consumer attitude and purchase intention toward green energy brands: The roles of psychological benefits and environmental concern.” *Journal of Business Research* 65, 1254–1263 (2012)

Hayes, Andrew F (2013), “Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-based Approach” New York, NY: Guilford Press.

Hoffman, D.K. (2003) “Marketing + MIS = e-service”. *Communications of the ACM.* Vol 46 (6), pp53-55

Holloway, I.(1997) “Basic concepts for qualitative research.” Wiley-Blackwell

Honey MA, Bonvillian WB, Cannon-Bowers J, Klopfer E, Pellegrino JW, Perez R, Pinkard N, Schwartz D, Steinkuehler C, Wieman CE, Storksdieck M, Schwebach JR, Hilton ML, Krone R, Harvey P, Mukan W. (2011). “Learning Science Through Computer Games and Simulations”. Washington, DC: The National Academies Press. https://doi.org/10.17226/13078.

Hori, Y., Tokuda, Y., Miura, T., Hiyama, A., Hirose, M. (2013). “Communication pedometer: a discussion of gamified communication focused on frequency of smiles.” In Proceedings of the 4th augmented human international conference, pp.206-212

Huotari, K., & Hamari, J. (2012). “Defining gamification – a service marketing perspective.” *In Proceedings of the 16th International Academic MindTrek Conference* (pp. 17–22), Tampere, Finland, 3–5 October, 2012.

Hunicke, R., Leblanc, M., Zubek, R. (2004). “MDA: A Formal Approach to Game Design and Game Research”. In *Proceedings of AAAI-04 workshop on Challenges in Game AI*, pp.1-5

Jackson, S. A. (2012): “Flow” In R. Ryan (Ed), The Oxford handbook of human motivation. New York: Oxford University Press (Oxford library of psychology).

Jacobs, A., Timmermans, A., Michielsen, M., Vander Plaetse, M. & Markopoulos, P. (2013). “CONTRAST: Gamification of Arm-hand Training for Stroke Survivors. *CHI '13” Extended Abstracts on Human Factors in Computing Systems* (p./pp. 415--420), New York, NY, USA: ACM. ISBN: 978-1-4503-1952-2

Kaae S, Traulsen JM.(2015) “Qualitative methods in pharmacy practice research.” In: Babar Z-U-D, ed. Pharmacy Practice Research Methods. Switzerland: Springer International; 2015: 49–67.

Kapp, K.M. (2012). “The Gamification of Learning and Instruction: Game based Methods and Strategies for Training and Education”, San Francisco, CA: Pfeiffer

Kondracki, N. L.,&Wellman, N. S. (2002). “Content analysis: Review of methods and their applications in nutrition education.” *Journal of Nutrition Education and Behavior*, *34*, 224-230.

Kong, J.S.L, Kwok, R.C.W, Fang, Y (2012). “The effects of peer intrinsic and extrinsic motivation on MMOG game-based collaborative learning.” *Information & Management*, 49 (1), pp. 1-9.

Kosmadoudi, Z., Lim, T., Ritchie, J., Louchart, S., Liu, Y., & Sung, R. (2013). “Engineering design using game-enhanced CAD: the potential to augment the user experience with game

elements". *Computer-Aided Design*, 45(3), 777-795. http://dx.doi.org/10.1016/j.cad.2012.08.001

Kotler, P., (1988). "Marketing Management: Analysis, Planning and Control". 6th ed. Prentice Hall, Englewood Cliffs, NJ.

Kotsopoulos, D., Bardaki, C., Lounis, S., and Pramatari, K. (2017) "Effecting Employee Energy Conservation Behaviour at the Workplace by utilising Gamification". *Twenty-Fifth European Conference on Information Systems (ECIS)*

Kotsopoulos, D., Bardaki, C., Lounis, S., Papaioannou T., and Pramatari, K. (2017) "Designing an IoT-enabled Gamification application for Energy Conservation at the Workplace: Exploring Personal and Contextual characteristics". *30th Bled eConference*

Kuntz, K., Shukla, R., Bensch, I.(2012) "How Many Points for That? A Game-Based Approach to Environmental Sustainability". In: *ACEEE Summer Study on Energy Efficiency in Buildings*, Pacific Grove, CA, pp. 126–137 (2012)

Kuo, M.-S., Chuang, T.-Y. (2016). "How gamification motivates visits and engagement for online academic dissemination – An empirical study". *Computers in Human Behavior*. Volume 55, pp 16-27

Landers, R.N., Bauer, K.N., Callan, R.C. (2015) "Gamification of task performance with leaderboards: A goal setting experiment". *Computers in Human Behavior*, Vol 71 pp 508-515.

Lee, J., Hammer, J. (2011) "Gamification in education: What, how, why bother?" *Academic Exchange Quarterly* 15(2)

Li, W., Grossman, T., Fitzmaurice, G. (2012). "Gamicad: a gamified tutorial system for first time auto-cad users." In Proceedings of the *25th annual ACM symposium on user interface software and technology*, pp. 103-112

Li, Z., Huang, K.W, Cavusoglu, H. (2012). "Quantifying the Impact of Badges on User Engagement in Online Q&A Communities". In Proceedings of the *International Conference on Information Systems, ICIS 2012*, Orlando, Florida, USA

Lincoln, Y. S., & Guba, E. G. (2000). "Paradigmatic controversies, contradictions, and emerging confluences." In N. K. Denzin & Y. S. Lincoln (Eds.), The handbook of qualitative research (2nd ed., pp. 163–188). Beverly Hills, CA: Sage.

Lindkvist, K. (1981). "Approaches to textual analysis." In K. E. Rosengren (Ed.), *Advances in content analysis* (pp. 23-41). Beverly Hills, CA: Sage.

Liu, Y., Alexandrova, T., Nakajima, T., (2011). "Gamifying intelligent environments". In: Proceedings of the 2011 International ACMWorkshop on Ubiquitous Meta User Interfaces. Presented at Ubi-MUI'11. ACM, pp. 7–12

Locke, E. A. (1968). "Toward a theory of task motivation and incentives". Organizational Behavior & Human Performance, 3,p157-189. http://dx.doi.org/10.1016/ 0030-5073(68)90004-4.

Lounis S., Pramatari K., Theotokis, A., (2014) "Gamification is all about fun: The role of Incentive Type and Community Collaboration." *In proceedings of the 22nd European Conference on Information Systems – ECIS 2014*, Tel Aviv, Israel, June 9-11, 2014

Lounis, S., Neratzouli X., Pramatari K. (2013). “Can Gamification Increase Consumer Engagement? A Qualitative Approach on a Green Case”. In Proceedings of the 12th IFIP Conference on e-Business, e-Services, e-Society, Doulgeris,C., Nineta, P.

Lounis, S., Kotsopoulos, D., Bardaki, C., Papaioannou T. and Pramatari, K., "Waste no more: Gamification for energy efficient behaviour at the workplace" (2017). GamiFIN Conference 2017.

Lunneborg, C. E. (2000). “Data analysis by resampling.” Pacific Grove, CA: Duxbury.

MacFarland, T.W. (2012). “Two-Way Analysis of Variance: Statistical Tests and Graphics Using R, “ Springer Briefs in Statistics 1, DOI 10.1007/978-1-4614-2134-4 1

Malhotra, Naresh K and David F Birks (2006), “Marketing Research: An Applied Approach “ European, Gosport, UK: Prentice Hall.

Malhotra, N. K., S. S. Kim, and J. Agarwal (2004), "Internet users' information privacy concerns (IUIPC): The construct, the scale, and a causal model," *Information Systems Research,* 15 (4), 336-55.

Markets and Markets. (2016). “Gamification market by solution (consumer driven and enterprise driven), applications (sales and marketing), deployment type (On-Pre- mises and cloud), user type (large enterprise, SMBs), industry and region - global forecast to 2020”. http://www.marketsandmarkets.com/Market-Reports/gamification-market-991.html. (Accessed January 3, 2017)

Martin, W., Bridgmon, K. (2012) “Quantitative and Statistical Research Methods: From Hypothesis to Results”. First Edition. John Wiley & Sons ISBN 978-0-470-63182-9

Mason M. (2010) “Sample size and saturation in PhD studies using qualitative interviews.” *Forum Qualitative Social Research.* Volume 11, Number 3 Article 8, September 2010.

Massung, E., Coyle, D., Cater, K., Jay, M., Preist, C., (2013). “Using crowdsourcing to support pro-environmental community activism.” In: Proceedings of the *2013 ACMSIGCHI Conference on Human Factors in Computing Systems. Presented at CHI'13.* ACM, Paris, France, pp. 371–380

Mathe, H. and R.D. Shapiro (1993), “Integrating Service Strategy in the Manufacturing” Company. London: Chapman & Hall.

Matsumoto, David Ricky (2009), “The Cambridge Dictionary of Psychology”, Cambridge, UK: Cambridge University Press.

Matthing, J., Kristensson, P., Gustafsson, A., Parasuraman, A. (2006) “Developing successful technology-based services: the issue of identifying and involving innovative users.” *Journal of Services Marketing* 20(5), 288–297 (2006)

Matthing, J., B. Sanden, and B. Edvarsson (2004), "New service development: learning from and with customers," *International Journal of Service Industry Management,* 15 (5), 479-98.

Marache-Francisco, C., and Brangier, E., (2013) “Process of Gamification. From the consideration of gamification to its practical implementation.” Conference: CENTRIC 2013: *The Sixth International Conference on Advances in Human oriented and Personalized Mechanisms, Technologies, and Services,* At Venice, Italy

McAuley, E., Duncan, T., & Tammen, V. V. (1987). “Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: A confirmatory factor analysis.” *Research Quarterly for Exercise and Sport*, 60, 48-58.

McDaniel, R., Lindgren, R., Friskics, J., (2012). “Using badges for shaping interactions in online learning environments.” In: Proceedings of the 2012 IEEE International Professional Communication Conference. Presented at IPCC 2012. IEEE, Orlando, FL, pp. 1–4.

Mekler, E. D., Bruhlmann, F., Opwis, K., & Tuch, A. N. (2013). “Do points, levels and leaderboards harm intrinsic motivation?: an empirical analysis of common gamification elements.” In Proceedings of the *First International Conference on Gameful Design, Research, and Applications* (pp. 66-73). ACM.

Mekler, E. D., Bruhlmann, F., Tuch, A. N. and Opwis, K., (2015) “Towards understanding the effects of individual gamification elements on intrinsic motivation and performance”, *Computers in Human Behavior* (2015), http://dx.doi.org/10.1016/j.chb.2015.08.048

Miles, M. B.,&Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook.* Thousand Oaks, CA: Sage.

Montola, M., Nummenmaa, T., Lucero, A., Boberg, M., Korhonen, H. (2009). “Applying game achievement systems to enhance user experience in a photo sharing service.” In Proceedings of the *13th international MindTrek conference:* Everyday life in the ubiquitous era, pp.94-97

Morgan, D. L. (1993). “Qualitative content analysis:Aguide to paths not taken.” *Qualitative Health Research, 3*, 112-121.

Morschheuser, B., Hamari, J., Koivisto, J., Maedche, A. (2017) “Gamified crowdsourcing: Conceptualization, literature review and future agenda”. *International Journal of Human-Computer Studies.* Vol 106 pp 26-43. doi: http://dx.doi.org/10.1016/j.ijhcs.2017.04.005

Morse, J. M., & Field, P. A. (1995). *Qualitative research methods for health professionals* (2nd ed.). Thousand Oaks, CA: Sage.

Musthag, M., Raij, A., Ganesan, D., Kumar, S., Shiffman, S., (2011). “Exploring micro-incentive strategies for participant compensation in high-burden studies.” In: Proceedings of the 13th International Conference on Ubiquitous Computing. Presented at UbiComp'11. ACM, pp. 435–444.

Mutter, T., Kundisch, D. (2014). “Don’t take away my status! – Evidence from the restructuring of a virtual reward system.” *Computer Networks*, Volume 75, September 2014, pp 477-490

Mylonopoulos, Nikolaos A. and Georgios I. Doukidis (2003), "Introduction to the Special Issue: Mobile Business: Technological Pluralism, Social Assimilation, and Growth," in *International Journal of Electronic Commerce* Vol. 8: M.E. Sharpe Inc.

Nagle A., Wolf, P., Riener, P. (2016) “Towards a system of customized video game mechanics based on player personality: Relating the Big Five personality traits with difficulty adaptation in a first-person shooter game”, *Entertainment Computing*, Volume 13, March 2016, Pages 10-24, ISSN 1875-9521, https://doi.org/10.1016/j.entcom.2016.01.002.

Nicholson, S., (2012). “A user-centered theoretical framework for meaningful gamification”. In: Proceedings of Games Learning Society 8.0. Madison, WI

Nunnaly, J. C., and Bernstein, I. H. (1994). Psychometric theory. Sydney: McGraw-Hill

Passos, E.B., Medeiros, D.B., Neto, P.A.S., Clua, E.W.G., (2011). "Turning real-world software development into a game." In: Proceedings of *SBGames 2011*. Presented at SBGames 2011. Salvador, pp. 260–269.

Patton MQ. (2002) "Qualitative Research and Evaluation Methods", 3rd ed., Thousand Oaks: Sage Publications;

Pavlou, Paul A. (2003), "Consumer Acceptance of Electronic Commerce: Integrating Trust and Risk with the Technology Acceptance Model," *International Journal of Electronic Commerce*, 7, 101-134.

Pedreira, O., Garcia, F., Brisaboa, N., Piattini, M. (2015) "Gamification in software engineering - A systematic Mapping." *Information and Software Technology.* Volume 57 pp157-168 http://dx.doi.org/10.1016/j.infsof.2014.08.007

Phillips. D.C., and Burbules, N. (2000) "Postpositivism and Educational Research." Rowman & Littlefield. ISBN 0847691225

Plant, R. W., & Ryan, R. M. (1985). "Intrinsic motivation and the effects of self-consciousness, selfawareness, and ego-involvement: An investigation of internally controlling styles." *Journal of Personality*, 53, 435-449.

Popescu, M. M., Romero, M., and Usart, M. (2013). "Serious games for serious learning using SG for business, management and defence education." *Int. J. Comput. Sci. Res. Appl.* 3, 5–15. Available online at: http://www.ijcsra.org/ current-issue/v3i1

Preacher, K. J. and Hayes A.F. (2008), "Asymptotic and Resampling Strategies for Assessing and Comparing Indirect Effects in Multiple Mediator Models," *Behavior Research Methods*, 40 (3), 879–91.

Przybylski, A. K., Rigby, C. S., & Ryan, R. M. (2010). "A motivational model of video game engagement." *Review of General Psychology*, 14(2), p154-166.

Przybylski, A. K., Weinstein, N., Ryan, R. M., & Rigby, C. S. (2009). "Having to versus wanting to play: Background and consequences of harmonious versus obsessive engagement in video games". *CyberPsychology & Behavior*, 12(5), p485-492. http://dx.doi.org/10.1089/cpb.2009.0083

Reeves, B. and Read, J. (2009) "Total engagement: How games and virtual worlds are changing the way people work and businesses compete". *Harvard Business Review Press.* November 2 2009 ISBN: 142214657X.

Reeve, J., & Deci, E. L. (1996). "Elements of the competitive situation that affect intrinsic motivation." *Personality and Social Psychology Bulletin*, 22, 24–33.

Richter, G., and Raban, D. (2012) "Schedules of reinforcement and game experience" *MCIS 2012* Proceedings. Paper 35.

Rigby, C. S., & Ryan, R. M. (2011). "Glued to games: How video games draw us in and hold us spellbound". Santa Barbara: Praeger

Roberts, J.: (1996) "Green consumers in the 1990s: profile and implications for advertising." *Journal of Business Research* 36(3), 217–231

Rodrigues, L.F., Costa, C.J., Oliveira, A. (2016). "Gamification: A framework for designing software in e-banking." *Computers in Human Behavior*. Volume 62, pp 620-634. http://dx.doi.org/10.1016/j.chb.2016.04.035

Rose, D.H., Meyer, A., (2002). "Teaching Every Student in the Digital Age: Universal Design for Learning." *Association for Supervision and Curriculum Development*, Alexandria, VA

Ryan, R. M., and Deci, E. L. (2000). "Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being." *American Psychologist* (55), pp. 68-78.

Ryan, R.M., Rigby, C.S., Przybylski, A. (2006). "The Motivational Pull of Video Games: A Self- Determination Theory Approach." *Motivation and Emotion* 30 (4), pp. 344-360.

Ryan, R. M., Koestner, R., & Deci, E. L. (1991). "Varied forms of persistence: When free-choice behavior is not intrinsically motivated." *Motivation and Emotion*, *15*, 185-205

Ryan, R. M., Mims, V., & Koestner, R. (1983). "Relation of reward contingency and interpersonal context to intrinsic motivation: A review and test using cognitive evaluation theory". *Journal of Personality and Social Psychology*, *45*, 736-750

Sailer M., Hense, J.U., Myer, S.K., Mandl, H. (2017) "How gamification motivates: An experimental study of the effects of specific game design elements of psychological need satisfaction." *Computers in Human Behavior*, Vol 69 p371-380.

Sakamoto, M., Nakajima, T., Alexandrova, T., (2012). *Value-based design for gamifying daily activities.* In: Errlich, M., Malaka, R., Masuch, M. (Eds.), Entertainment Computing –ICEC 2012, Lecture Notes in Computer Science. Springer; New York, NY, pp. 421–424

Salen, K. and Zimmerman, E. (2004). "Rules of Play, Game Design Fundamentals". Cambridge, MA: MIT Press.

Saltzman, M. (2000). "Game Design: Secrets of the Sages. Second edition" Indianapolis IN: Macmillan Publishing

Seaborn, K., and Fels, D.I. (2015). "Gamification in theory and action: A survey". *International Journal of Human-Computer Studies* Volume 74 pp 14-31

Sillaots, M. (2014) "Achieving Flow Through Gamification: A Study on the Re-Designing Research Methods Courses." In *Proceedings of the European Conference on Games Based Learning* Vol 2 P538

Simoes, J., Redondo, R.D., Fernandez Vilas, A. (2013). "A social gamification framework for a K-6 learning platform". *Computers in Human Behavior*. Vol 29, pp 345-353. http://dx.doi.org/10.1016/j.chb.2012.06.007

Simon, Francois and Jean-Claude Usunier (2007), "Cognitive, demographic, and situational determinants of service customer preference for personnel in contact over self service technology," *International Journal of Research in Marketing*, 24, 163-73.

Smith, A.L. and Baker, L. (2011) "Getting a clue: creating student detectives and dragon slayers in your library", Reference Services Review, 39(4), 2011, pp. 628-642.

Snyder, E., Hartig, J., (2013). "Gamification of board review: a residency curricular innovation|. *Med. Educ.* 47, 524–525. http://dx.doi.org/10.1111/medu.12190.

Song, H., Kim, J., Tenzek, K. E., & Lee, K. M. (2010). “Intrinsic motivation in exergames: Competition, competitiveness, and the conditional indirect effect of presence.” In Paper presented at the annual meeting of the International Communication Association,Singapore, June 2010

Straub, D., D. Gefen, and M.C. Boudreau (2005), "The ISWorld Quantitative, Positivist Research Methods Website."

Straughan, R.D., Roberts, J.A.(1999) “Environmental segmentation alternatives: a look at green consumer behavior in the new millennium.” *Journal of Consumer Marketing* 16(6), 558–575 (1999)

P. Spronck, M. Ponsen, I. Sprinkhuizen-Kuyper, E. Postma (2006) “Adaptive game AI with dynamic scripting”, *Mach. Learn.* 63 (2006) 217–248, http://dx.doi.org/ 10.1007/s10994-006-6205-6.

Straughan, J., Roberts, A. (1999). “Environmental segmentation alternatives: a look at green consumer behavior in the new millennium”. *Journal of Consumer Marketing*, 16 (6), pp.558 – 575.

Tauer, J., and Harackiewicz, J. (1999) “Winning isn’t Everything : Competition, Achievement Orientation and Intrinsic Motivation”. *Journal of Experimental Psychology* (35:3) pp 209-238

Terlutter, R., Capella, M.L., (2013). “The gamification of advertising: analysis and research directions of in-game advertising, advergames, and advertising in social network games”. *Journal of Advert*. 42, 95–112. http://dx.doi.org/10.1080/ 00913367.2013.774610.

Tesch, R. (1990). “Qualitative research: Analysis types and software tools.” Bristol, PA: Falmer.

Thom, J., Millen, D., DiMicco, J., (2012). “Removing gamification from an enterprise SNS”. In: Proceedings of the *ACM 2012 Conference on Computer Supported Cooperative Work*. Presented at CSCW'12. ACM, Seattle, WA, pp. 1067–1070

Thomke, S. and E Von Hippel (2002), "Customers as innovators: a new way to create value," Harvard Business Review, 80 (April), 74-81.

Tjosvold, D., Johnson, D. W., Johnson, R. T., & Sun, H. F. (2006). “Competitive motives and strategies: Understanding constructive competition”. Group Dynamics: Theory Research and Practice, 10(2) pp87-99

Vallerand, R. J., & Losier, G. F. (1999). “An integrative analysis of intrinsic and extrinsic motivation in sport”. *Journal of Applied Sport Psychology*, 11(1), pp. 142–169.

Vansteenkiste, M., & Ryan, R. M. (2013). “On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle”. *Journal of Psychotherapy Integration*, 23(3), 263e280. http://dx.doi.org/ 10.1037/a0032359.

Vansteenkiste, M., Lens, W., Deci, E. L. (2006). “Intrinsic versus extrinsic goal contents in self determination theory: Another look at the quality of academic motivation.” *Educational Psychologist*, 41, pp. 19-31.

Vansteenkiste, M., Niemiec, C. P., & Soenens, B. (2010). “The development of the five mini-theories of self-determination theory: An historical overview, emerging trends, and future directions”. In T. C. Urdan, & S. A. Karabenick (Eds.), The decade Ahead: Theoretical

perspectives on motivation and achievement (advances in motivation and achievement (Vol. 16 A, pp. 105e165). London: Emerald Group Publishing Limited

Venkatesh, V., Michael G. M., Davis G. B., and Davis F.D. (2003), "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly*, 27 (3), 425-78.

Vetter, R. (2001) "The wireless web". *Communications of the ACM*. Vol 44(3) pp 60-61

Vrechopoulos, A.P., Keefe, R.M.O., Doukidis, G.I., and Siomkos, G.J. (2004), "Virtual store layout: an experimental comparison in the context of grocery retail," *Journal of Retailing*, 80 (1), 13-22.

Vygotsky,L.S. (1978). "Mind in Society: The development of higher psychological processes", Harvard University press, Cambridge, 1978, pp. 92–104.

Werbach K. & Hunter D. (2012). "For the Win: How Game Thinking Can Revolutionize Your Business". Wharton Digital Press.

Wiser, R. (1998) "Green power marketing: increasing customer demand for renewable energy." *Utilities Policy* 7(2), 107–119

Wood, M. (2005). "Bootstrapped confidence intervals as an approach to statistical inference". *Organizational Research Methods*, 8, 454–470.

Xu, Heng, Lih-Bin Oh, and Hock-Hai Teo (2009), "Perceived effectiveness of text vs. multimedia Location-Based Advertising messaging," *International Journal of Mobile Communications*, 7, 154-77.

Xu, Y., Poole, E.S., Miller, A. D., Eiriksdottir, E., Catrambone, R., Mynatt, E. (2012). "Designing pervasive health games for sustainability, adaptability and sociability". In Proceedings of the International Conference on the Foundations of Digital Games, New York, USA, pp. 49-56.

Yee, N. (2006). "Motivations for Play in Online Games". *CyberPsychology & Behavior*, 9 (6), pp. 772 - 775.

Zeithaml, Valarie A., Mary Jo. Bitner, and Dwayne Gremeler (2008), "Services Marketing". New York : McGraw Hill.

Zhao, Xinshu, John G. Lynch Jr., and Qimei Chen (2010), "Reconsidering Baron and Kenny: Myths and Truths about Mediation Analysis," *Journal of Consumer Research*, 37 (2), 197–206.

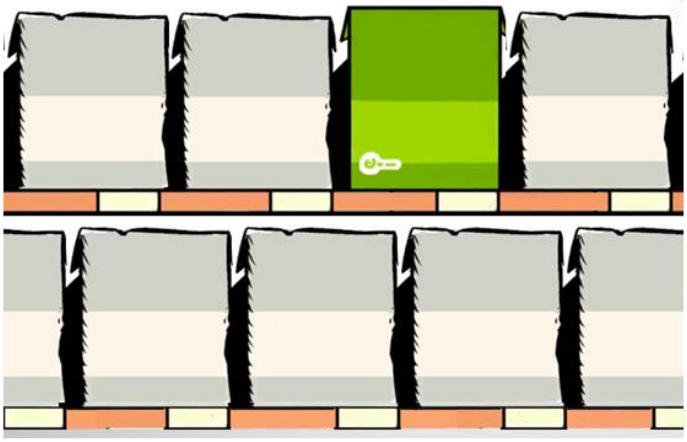
Zichermann Gabe and Cunningham Christopher, (2011), *Gamification by Design: Implementing Game Mechanics in Web and Mobile Apps*, First edition, Sebastopol: O'Reilly Media, ISBN 978-1-449-39767-8

ANNEX 1: Laboratory Experiment Narrative and Stimuli

Upon arrival at the laboratory experiment's premises, the subjects are exposed to a common introductory narrative and when they proceed in the experiment they are randomly placed in one on of the four versions of the interactive mockups. The interactive mockup is preceded by the introductory narrative per treatment as follows.

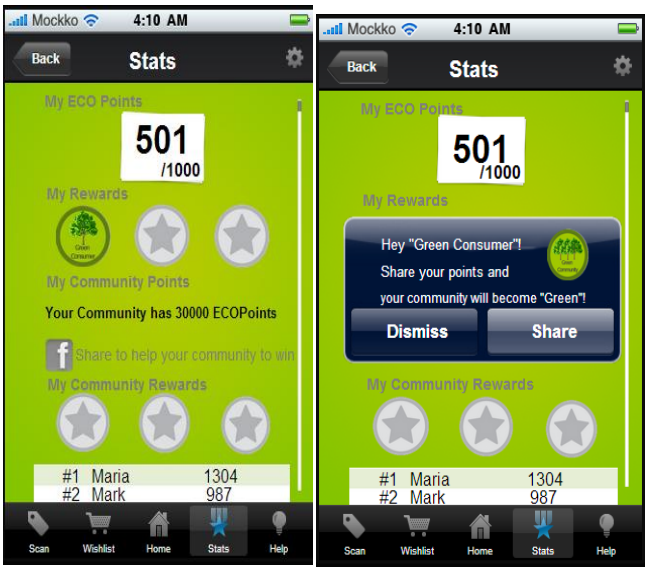
---------- Introductory Narrative ----------

You enter in a supermarket with the intent to purchase a product. Whilst being in front of the shelf at your desired product category you notice that there is a known to you product with an environmentally friendly signage. Currently there is a game in progress pertinent to the environment. Its goal is to reduce the environmental footprint of the products with the active participation of consumers. The game is free and participation is not obligatory. This game gives the opportunity to collect points for every purchase of an environmentally friendly product. The points collected can be utilized based on the following. Click on the following image if you want to experience the game and proceed in the experiment.



-- Narrative Case: Intrinsic Oriented Rewards and Community Collaboration --

You are in front of the shelf of the product category you wish to purchase. The product that is environmentally friendly can in the case of purchase award you with 100 points. The 100 points you can be awarded in case you choose it can give you the ability to contribute to the community and get one step closer to becoming a "Green Community" and receive the respective visual representation of a communal achievement. The service is free for you to explore.

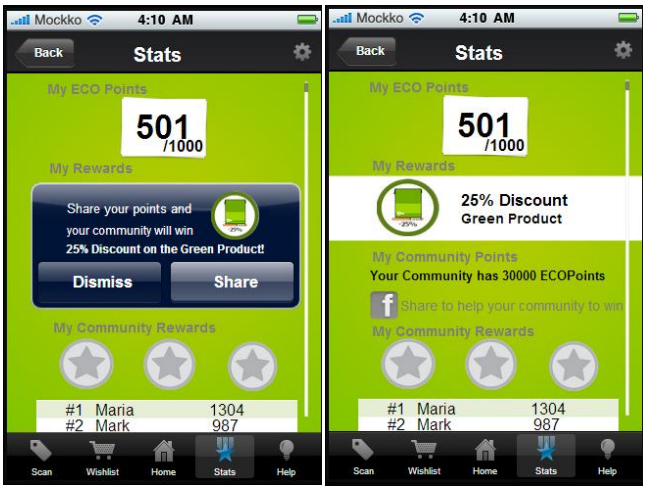


-- Narrative Case: Intrinsic Oriented Rewards and Single play --

You are in front of the shelf of the product category you wish to purchase. The product that is environmentally friendly can in the case of purchase award you with 100 points. The 100 points you can be awarded in case you choose it can give you the ability to get one step closer to becoming a "Green Consumer" and receive the respective visual representation of your personal achievement. The service is free for you to explore.

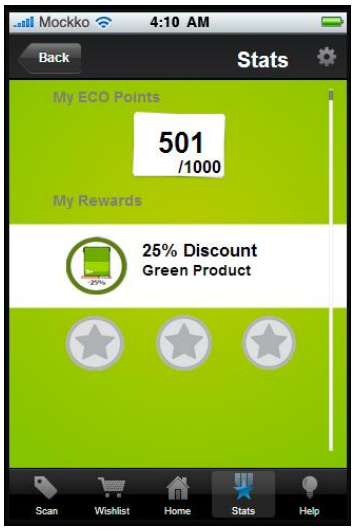
-- Narrative Case: Extrinsic Oriented Rewards and Community Collaboration --

You are in front of the shelf of the product category you wish to purchase. The product that is environmentally friendly can in the case of purchase award you with 100 points. The 100 points you can be awarded in case you choose it can give you the ability to get one step closer to enable your community to receive a discounted price for future purchases of similar products. The service is free for you to explore.



-- Narrative Case: Extrinsic Oriented Rewards and Single play --

You are in front of the shelf of the product category you wish to purchase. The product that is environmentally friendly can in the case of purchase award you with 100 points. The 100 points you can be awarded in case you choose it can give you the ability to get one step closer to receive a discounted price for future purchases of similar products. The service is free for you to explore.



ANNEX 2: Laboratory Experiment Questionnaires

Lab Experiment Intro Questionnaire

Athens University of Economics and Business

In the following section you can state the degree of your agreement or disagreement with the following statement in the 7-point scale (1= Totally Disagree, 7=Totally agree)		Totally Disagree -1	2	3	4	5	6	Totally agree - 7
1	I make every effort to buy paper products made from recycled paper							
2	To save energy, I drive my car as little as possible							
3	Whenever possible I buy products in reusable containers							
4	I try to only buy products that can be recycled							
5	I have switched products for ecological reasons							
6	When I have a choice between two equal products I always purchase the on which is less harmful to other people and the environment							
7	I have tried very hard to reduce the amount of electricity I use							
8	I have purchased light bulbs that were more expensive but saved energy							

Do you play games in a smartphone or a tablet?

□ YES □ NO

|-> *(if yes)* How often do you play games in your smartphone/tablet in an average week.

□ <1 Hour □ 1-5 Hours □ 5-10 Hours □ >10 Hours

|-> *(if yes)*

In the following section you can state the degree of your agreement or disagreement with the following statement in the 7-point scale (1= Totally Disagree, 7=Totally agree) I play games in your smartphone or tablet in order to…		Totally Disagree -1	2	3	4	5	6	Totally agree - 7
1	Maintain a relationship I value							
2	Improve a relationship							
3	Find something to talk about							
4	Forget my problems							
5	Feel less lonely							
6	Impress other people in the game							
7	To feel important							
8	Find a way to pass the time							

Sex	□ Male □ Female
Age	□ 18-24 □ 25-35 □ 36-44 □ 45-55 □ 55 +
Education	Highschool □ Undergraduate □ Postgraduate □ Other □

Lab Experiment Post Questionnaire

Athens University of Economics and Business

Based on your experience with the gamified electronic service please complete the following brief questionnaire.

In the following section you can state the degree of your agreement or disagreement with the following statement in the 7-point scale (1= Totally Disagree, 7=Totally agree)		Totally Disagree -1	2	3	4	5	6	Totally agree - 7
1	Within the service you were able to share your points with a community							
2	Within the service you were able to receive discounted price upon future purchase of products							
3	The gamified service will not be interesting							
4	The gamified service will be entertaining							
5	The gamified service will not be fun							
6	The gamified service will be entertaining							

In the service you experienced how would you describe your feelings towards using the service?

Good								Bad
Pleasant								Unpleasant
Favorable								Unfavorable

In the service you experienced how likely are you to use the service ?

Likely								Unlikely

Possible								Impossible

In the smartphone application you experienced how likely are you to use the smartphone application ?

Likely								Unlikely
Possible								Impossible

ANNEX 3: POOLL Non-Game Context's Questions

Environmental Awareness Questions

A/A	Questions	ANSWER 1	ANSWER 2	C	Response
1	Which of the following modes of transportation is the most environmental friendly?	By Car	By Bus	2	Taking the bus and in general using public transportation can reduce the greenhouse emissions. Imagine everyone that commutes and can be served by a bus, taking their own car.
2	In order to be more environmental friendly would you reuse something you own or buy something new?	Reuse	Buy	1	Manufacturing new products requires natural captial and resources. So every product in a household made an impact on the environment and by choosing to reuse instead of buy we are part in a sustainable global strategy.
3	Meal is over, and there are leftovers. Should we throw away or compost ?	Throw away	Compost	2	Everything we throw away goes somewhere… So Reducing the amount of waste is a way to protect the environment. If the product is eligible for composting, you can compost it.
4	True or False ? Throwing away is better than recycling.	TRUE	FALSE	2	Recycling is a way to reduce the amount of waste and a great way to support a sustainable lifestyle.
5	Splish splash, teeth are clean. Should I turn off faucets when I brush my teeth?	Yes	No	1	Water is on of the most important recourses of the planet so we should do our best to conserve it. By tunring off faucets that are running unnecessarily (like when brushing our teeth) we actively help the environment
6	USA or China produces the most greenhouse gas emissions?	USA	China	2	At the top of the list of global greenhouse gas emitters China beat USA in 2006-07 because of the rising industrial sector.
7	Light me up. Which of the following lightbulb types uses the least energy?	Incandescent	Compact fluorescent	2	A compact fluorescent light bulb type uses 60-80% less energy than a standard incandescent light bulb type
8	Lights, ON. Which of the following lightbulb types uses the least energy?	Compact fluorescent	Halogen	1	A compact fluorescent light bulb type uses 60-80% less energy than a standard Halogen light bulb type
9	Climate changes. According to the World Health Organization, how many deaths per year are attributed to climate change ?	150.000	1.500.000	1	Because of extreme weather conditions, drought, heat waves and resulting consequences the World Health Organization attribute 150.000 deaths annually to climate change
10	Carbon dioxide be gone! How long untill it disperses in the atmosphere?	50 Years	100 Years	2	It takes a lot… about 100 years! So every carbon dioxide emission will remain and affect for decades to come
11	Where is my snowman? Is Global warming affected by the reduction of global snow and ice cover?	Yes	No	1	All ice-covered surfaces reflect more solar energy than non covered surfaces. That helps in global cooling. So if ice-covered surfaces are reduced… temperature goes up.
12	If global temperature rises and gets warmer and warmer, what happens to malaria?	It rises	It drops	1	A rising temperature would allow the mosquitoes to survive at higher alltitudes. That can bring them to regions that lack population immunity. Not only that, but tha transmission periode for diseases like malaria is increased by expanded warm periods (source WHO)
13	Time to do the dishes. Which of the following uses less water, washing a full load of dishes by hand or in the dishwasher?	By Hand	Dishwasher	2	If you hand wash the dishes than you can use up to 50% more water than a water-saving energy efficient dishwasher!!! Keep in mind though that dishwashers made before 1994 use more water than current models.
14	Groceries time! When going to a supermarket which of the following is a more eco-friendly method to carry your products ?	Paper Bag	Reusable Bag	2	As, manufacturing and disposing of both plastic and paper bags harms the environment it is better to bring our own reusable bags instead.
15	TV off, time to sleep. When you turn off your TV does it consume energy?	Yes	No	1	Many appliances (like the TV) continue to use energy even when they are off for features like clocks and remote control sensors.
16	So we have renewable sources. How much of global electricity	8%	20%	8%	It is astonishing that only 8% of global energy comes from renewable sources… The remaining 92% ? Oil, Coal, Gas and

	output is produced by them?				other non-renewable sources!
17	Saving money and helping the environment? Yes it is possible. By replacing a single incadescent light bulb with a compact fluorescent light how muh money do you save approximately?	10 $	30 $	2	By replacing a 60 watt incandescent with a 13 watt CFL you can save about $30 in energy costs over the life of the bulb according to the U.S. Environmental Protection Agency
18	It's cold outside but how sustainable is the heat inside? In heating costs how much can you save by dropping the thermostat from 21.1 to 20 Celsius ?	1%	5%	2	It's the big 5! Each degree you drop the thermostat in winter time can save about 5% on your heating bill.
19	A Photovoltaic module is the fancy word for what exactly?	Sun panels	Solar panels	2	We know them as solar panels and they are responsible for producing energy from the sun. We can power thing up.
20	A talk about gases. Carbon dioxide, methane, nitrous oxide, and sulphur/sulfur hexafluoride are widely referred to by what collective metaphorical term?	Greenhouse Gases	Bluehouse Gases	1	All the aforementioned are the widely known Greenhouse Gases. They are the ones we should be trying to reduce.
21	How many tons of plastic and metal can be kept out of our landfills each year by recycling ink cartridges?	380.000 Tons	400.000 Tons	2	400.000 Tons. That is a big number of plastic and metal to keep out of landills each year by recycling ink cartridges.
22	Let's talk about oil and ink Cartidges! How much oil is required for the manufacturing of a single new cartidge?	10 Gallons	1 Gallon	2	Each new ink cartridge requires almost a gallon of oil. Is that too much?
23	Taking a shower: What percentage of household water use does the bathroom account for?	25%	70%	2	Well those long showers account for approximately 70% to 75% of household water usage
24	Ow that lovely refreshing freshwater. What percentage you think is out there?	11%	7%	2	Out of the entirety of water on earth only about 7% is freshwater ! Not only that, but 1% is readily available as drinking water as the rest is locked in the polar ice caps or deep underground
25	Do you love your Jeans and T-shirts? How much chemical fertilizer and pesticides does it take to grow the cotton to make one T-shirt and one pair of jeans?	10 Pounds	1 Pound	2	Well to make the Jeans and T-shirt we need about a pound of chemical fertilizer and pesticides for the cotton
26	Which of the following is the world's largest reef system?	Great Barrier Reef	Red Sea Coral Reef	2	The Great Barrier Reef located at the Coral Sean near Australia has a total length of 1,553 miles (2,500 km) where as the Red Sea Coral Reef near Israel is 1,180 miles (1,900 Km)
27	Buzzzzz… Do male or female mosquitoes bite people?	Male	Female	2	The buzz and pinch comes from female mosquitoes. A rise in the earths temperature enables mosquitoes to endure in higher altitudes and perhaps transmit diseases to larger population
28	A whole day dedicated to Earth? Yes, which one do you think?	18th June	22nd April	2	The 22nd of April is the Earth Day. Celebrate it by becoming more sustainable in your lifestyle
29	Which of the following is NOT one of the R's of recycling	Reduce	Remove	2	Reduce, Reuse and Recycle. The 3 R's of Recycling. Follow them and help the environment
30	True or False? Logging or Burning naturally occuring forests is known as "Deforestation"	TRUE	FALSE	1	Deforestation is the elimination of forests through logging and burning. Help fight deforestation and preserve the oxygen producing mechanisms of nature
31	Get back into nature… What term is used for something that will break down naturally?	Biodegradable	Biodissolvable	1	When something like a product can break down when discarded it is known as biodegradable. Look for the accompanying marking on products
32	Acid Rain, sounds dangerous right? What gas emitted by power stations can cause it?	Sulphur Monoxide	Sulphur Dioxide	2	Sulphur Dioxide can cause Acid Rain when emitted in the atmosphere. Be careful.

33	Species may stop existing saddly. What is that called?	Extinctio n	Distructio n	1	Spieces get extinct saddly, and it is in our best interest to prevent that from happening
34	Throwing away stays away? Which of the following takes the longest to degrade in a landfill?	Styrofoa m cup	Aluminu m can	1	Styrofoam takes even longer than an aluminum can to digrade, so dispose of that coffee cup responsibly.
35	Ow that Sunday newspaper… It's lovely to read. What next though? If everyone in the USA recyled their Sunday newspaper each week, how many trees per week would be saved?	500 k	50 k	1	Don't throw away your Sunday newspaper… If everyone recycles it then 500,000 trees per week can be saved
36	Grow renewable, Grow! What energy source is the fastest growing renewable energy source with worldwide power installed capacity reaching 14,000 MW ?	Solar	Wind	2	Wind is the answer. Grow renewables, grow like the wind
37	Make from recycled or make from scratch? The energy required to produce one aluminum soda can from raw metal could produce how many cans from recycled aluminum?	5	20	2	20 new cans. Using the recycled aluminum instead of the virgin to produce a new cap is 20 times more efficient.
38	Is it hot in here or is it just me? According to the National Academy of Sciences, the earth is the hottest it has been in the past:	40 years	400 years	2	Wow it sure is hot in here. Hotter than the past 400 years at least.
39	Recycling time: If we recycle one ton of paper, how many trees can we save?	26	17	2	Recycling paper is helpful for the environment. For every ton of paper we recycle 17 fully grown trees are saved
40	That glass looks familiar… How many times can glass be recycled and used?	Ten times	Unlimite d times	2	That glass looks familiar because it was recycled. The glass can be recycled as many times as we want. It never wears out !
41	That aluminum can… if it's recycled, how much recycled aluminum does it use?	30%	50%	2	Half! 50% of it is recycled. That is a great number for sustainability
42	Recyling for power! If you recycle one plastic bottle you could light a 60 watt bulb for	1 Hour	6 Hours	2	The energy saved from recycling one plastic bottle is roughly equivalent to 6 hours of lighting of a 60 watt light bulb
43	A glass bottle for my TV. The energy saved by recycling a glass bottle will run a TV for how long?	1 hour	5 hours	1	If you recycle a glass bottle the energy saved can run an average TV for about an hour
44	Recycle for power. If we recycle one ton of paper we can save enough energy to power WHAT for a year?	Compute r	House	2	The whole house! With one ton of paper recycled we have enough power to run a house for a year
45	Light up! A compact florescent light bulb uses how much of the energy needed for incandescent light bulbs?	25%	50%	1	A CFL uses a fourth of the energy required by an incandescent lighbulb
46	Time for work. Should I take my car or the bus?	Car	Bus	2	Taking the bus as opposed to taking the car can singificantly change our individual carbon emissions. By switching our daily commute to public transportation can reduce our carbon emissions by a staggering 10% !
47	Let's recycle that kilogram of paper to save ____ CO2.	0.1	0.4	2	If you recycle 1 Kg of paper, the total greenhouse benefits is 0.4 kg of CO2 equivalent. That is a great start !
48	I'll change the 100watt light bulb and put in an energy efficient one. Will it make any difference?	50 kg per year CO2	100 kg per year CO2	2	If you swap a single 100watt traditional light bulb for an energy saving light bulb then this will save approximately 100kg per year in CO2 equivalent. Not only that... but it will be cheaper on the bill as well.

49	Do we overeat or starve?	Overeat	Starve	1	Well, as there are 155 million overweight or obese people and in contrast 148 million undernourished people, we need to do something to change both.
50	Tomatoes, 100 gram. How much water is needed from start to finish?	9 Liters	19 Liters	2	For those delicious 100 grams of tomatoes the water needed during the entire lifecycle is 19 liters
51	A bottle for my PC. Recycling one bottle saves enough energy to power a computer for how long?	10 min	20 min	2	20 whole minutes. It's like a UPS. One recycled bottle can save enough energy to power a computer for 20 minutes
52	How many trees are cut down to support a human in his / her lifetime?	250	450	2	Actually it is 465 trees (for an average American). These are a lot of trees
53	True of False: Trash and litter we throw on the streets get swept up by big trucks.	TRUE	FALSE	2	Although street sweepers do what they can to keep the streets clean, much of the trash and litter end up in parks and rivers or the sea. We should use the trash bins.
54	That warm fleece jacket. It's made from how many recycled plastic bottles?	25	50	1	If you recycle 25 plastic bottles you have enough required to produce a fleece jacket.
55	A 10 minute glass powered washing machine?	TRUE	FALSE	1	Well if you recycle one glass bottle you save enough energy to operate a washing maching for about 10 minutes
56	It's tea time. I'll recycle 2 glass bottles to save the energy required to boil ____ cups of tea	2	5	2	Tea for everyone. 5 cups of tea, can be prepared with the same amount of energy saved from recycling 2 glass bottles
57	What don't I need when manufacturing glass bottles	Sand	Dirt	2	Manufacturing glass bottles requires sand yet not dirt.

ANNEX 4: Field Experiment Questionnaires

Field Experiment Intro Questionnaire

Welcome to the Pooll experiment. In short, you will fill out a survey, then you can download the Pooll smartphone app that you can experience as much as you like. After that you will fill out a second questionnaire. And that is all. As this process described above takes place in three different phases please fill out a valid e-mail you want to use throughout the experiment's phases. The e-mail will be used only in the context of the experiment and once completed it will be removed. Your whole experience will be anonymized.

E-mail:_____

Operating System of Your Mobile:_____

Please declare if you agree or disagree with each of the following statements, using the 7-point scale [1- Strongly Disagree, 7 - Strongly Agree]	1	2	3	4	5	6	7
When there is a choice, I always choose the product that contributes the least to environmental pollution							
If I understand the potential damage to the environment that some products can cause, I do not purchase these products							
I normally make a conscious effort to limit my use of products that are made of scarce resources							
When there is a choice between two equal products, I always purchase the one which is less harmful to other people and the environment							

Sex	□ Male □ Female
Age	□ 18-24 □ 25-35 □ 36-44 □ 45-55 □ 55 +
Education	Highschool □ Undergraduate □ Postgraduate □ Other □

Field Experiment Post Questionnaire

Welcome to the final questionnaire of the POOLL experiment you participated in. If you feel like you don't remember the app please open it up to remember it. The questionnaire should take about 7-8 minutes.

In the following provide the e-mail you used in the experiment

E-mail:_____

For each of the following statements, please indicate how true it is for you, using the following scale as a guide [1- Not at all true, 7 – Very true]	1	2	3	4	5	6	7
In the Pooll app I was able to compare my performance with the performance of others							
The more I was answering questions the easier it was to get points							
I noticed a change in the amount of points I got as I kept on playing							
I enjoyed doing this activity very much							
This activity did not hold my attention at all							
I would describe this activity as very interesting							
I think I am pretty good at this activity							
I think I did pretty well at this activity, compared to other participants							
I am satisfied with my performance at this activity							
I felt like I had to do this							
I answered the questions because I had no choice							
I felt very distant to the other participants of the activity							
I did this activity because I wanted to							
I feel close to the other participants in this activity							
I'd like a chance to interact with the participants of Pooll							
I don’t feel I could really trust the participants of Pooll							