

## MASTER

### Investigating the personalization of health gamification implementing personalized health games in the forensic psychiatric healthcare sector

van Wely, I.I.F.M.

*Award date:*  
2017

[Link to publication](#)

#### **Disclaimer**

This document contains a student thesis (bachelor's or master's), as authored by a student at Eindhoven University of Technology. Student theses are made available in the TU/e repository upon obtaining the required degree. The grade received is not published on the document as presented in the repository. The required complexity or quality of research of student theses may vary by program, and the required minimum study period may vary in duration.

#### **General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain

Eindhoven, October 2017

# **INVESTIGATING THE PERSONALIZATION OF HEALTH GAMIFICATION**

Implementing personalized health games in the forensic psychiatric healthcare sector

by

I.I.F.M. (Isabelle) Van Wely

BSc Industrial Engineering and Management Sciences for Healthcare – TU/e 2015

Student identity number 0773586

In partial fulfilment of the requirements for the degree of

**Master of Science**

**in Operations Management and Logistics for Healthcare**

1<sup>st</sup> supervisor TU/e: dr. P.M.E. (Pieter) Van Gorp, Information Systems, IE&IS

2<sup>nd</sup> supervisor TU/e: dr.ir. F. (Femke) Beute, Human Technology Interaction, IE&IS

3<sup>rd</sup> supervisor TU/e: dr. P.M. (Pascale) Le Blanc, Human Performance Management, IE&IS

1<sup>st</sup> supervisor GGzE: R.J.J. (Rob) Kimpen

2<sup>nd</sup> supervisor GGzE: M.J.W. (Mayke) Bankers

TUE. School of Industrial Engineering.

Series Master Theses Operations Management and Logistics.

Subject headings: Gamification, Healthcare, eHealth, mHealth, Forensic Psychiatry

“Being challenged in life is inevitable, being defeated is optional.”

— Roger Crawford



## Preface

By handing in this report, I am about to finish my master's degree in Operations Management and Logistics for Healthcare. Conducting this research was a great experience for me. I have grown in my academic knowledge, I have learned a lot about myself and I have created a lot of great memories during this graduation period. This project would not have succeeded without the help of a lot of people. Therefore, I would like to take the opportunity to thank them for their contributions and support.

First of all, I would like to thank my first supervisor, Pieter Van Gorp, for supporting me in conducting this project. Your stimulating attitude and both constructive and positive feedback have taken care of the fact that I have always challenged myself during this project. It helped me to continually improve my work and get the most out of it. I would also like to thank you for the confidence you had in me and that you gave me the opportunity to help you with different GameBus projects. I would also like to thank my second supervisor, Femke Beute, for taking the time to help me and provide very useful feedback throughout this entire project. Lastly, I would like to thank Pascale Le Blanc for making the time to be my third supervisor.

Secondly, I would like to thank my supervisors from De Woenselse Poort, Rob Kimpen and Mayke Bankers. I immediately felt at ease with you and had a great time during my graduation period. I would like to thank you for all the freedom you gave me for conducting this research, where you occasionally reminded me to take a step back in order to keep my research realistic in the available time. When I had questions, both of you were always there to answer them. Besides the substantive support, you also gave me personal support. I am very thankful for the uplifting conversations I could have with you and for all the good times we had. We had lots of laughs which made my master thesis project an unforgettable experience!

By handing in this master thesis, I am also closing my student life in Eindhoven. Six years ago, I moved to Eindhoven to start my bachelor Industrial Engineering for Healthcare. This was the start of a new adventure in a then unknown city for me. Now six years later, I feel at home in Eindhoven and I have grown as a person because of all the memories I have created besides studying. I would especially like to thank my friends for all the fun times we had during these six years. In addition to that, I would like to thank all of you for the support and for providing the positive distractions when I needed them during my graduation period.

I would also like to thank my parents, their partners and my sisters for their support and the trust you had in me during my student period. You always stood behind my decisions and I knew I could always turn to you for help and encouraging talks. Last but not least, I would like to thank my boyfriend for being there for me, you helped me and cheered me up during my lesser periods and you were there to focus on the great moments. Your support was very important for me!

I hope you will enjoy reading this master thesis!

Isabelle van Wely

## Executive summary

**Research area.** This master thesis was conducted at De Woenselse Poort (DWP), which is the forensic psychiatric department of the Association of Mental Health and Addiction Care in Eindhoven (GGzE). The mental healthcare sector is known for its complex nature and culture and is under high pressure in terms of regulations, cost savings, workload and patient expectations. Therefore, innovating in this sector is an evolution that cannot be ignored. Without innovation, the Dutch mental healthcare will not be able to deliver care to the increasing number of patients in the future at a fair price (Van der Horst & Ter Rele, 2013).

One of these possible innovations is the usage of eHealth to support and improve the mental healthcare. EHealth is the use of information and communication technology that is focusing directly on the mental well-being of the patients (NVZ, 2014). DWP wants to increase the usage of eHealth since it can increase a client's sense of empowerment, control and involvement in their own health, safety and recovery (DWP, 2017). This progressive look regarding eHealth of DWP has led to the development of the HKT-app. The HKT-app is very useful for investigating what the personal strengths and weaknesses are of a forensic psychiatric client in terms of their risk factors, since it is an application that is derived from a formal risk assessment instrument (HKT-R) (Zorginzicht, 2017). Currently, DWP has achieved individual successes regarding the usage of the HKT-app, but they have not yet succeeded in effecting organizational changes. The reason for this is that there is still much confusion among employees and clients about how the HKT-app can be best applied in their daily routines. More specifically, when the HKT-app is filled in by both the employee and client, they don't know how this can be translated to a daily treatment level. These uncertainties lead to a low motivation to apply the HKT-app in the client's treatment. Besides that, most of the clients inside DWP have a low motivation to comply to their treatment activities in general. This is a cause of concern, because non-compliance negatively affects both the desirable clinical and economic outcomes for an organization (Jin et al., 2008).

**Research objectives.** To overcome the problems that DWP is facing, this master thesis proposes the usage of GameBus to motivate the clients to comply to their treatment activities on the basis of their HKT-scores. In addition to that, it will investigate how the employees and clients of DWP can be supported in putting the HKT-app into practice. In other words, the research objective of this master thesis is twofold. Firstly, the first objective is to 'design a GameBus challenge that will motivate the clients in DWP to comply to their treatment'. Secondly, the subsequent objective is to 'develop a tool that can support employees of DWP to design a GameBus challenge for a client that will improve the execution of the HKT-app in their daily schedules'. To answer these research objectives two research questions should be answered. These questions are formulated as follows:

*Which design of GameBus achieves the highest motivation to comply to treatment of clients in DWP?*

*How can the findings from the implementation of GameBus be used for the development of a decision support tool for personalized GameBus challenges?*

The research design of this master thesis was based on the regulative cycle of Van Strien (1997). The main research questions were sub-divided into smaller sub-questions that could be designated to one of the steps of the regulative cycle and served as a guidance through the entire master thesis project. The steps that are used in the regulative cycle of Van Strien (1997) are: problem definition, diagnosis,

design, implementation and evaluation. The first research question was answered by iteratively testing different design decision in GameBus with the use of a small pilot study. The second research question was answered with the development of a prototype design of the decision support tool that was evaluated with several employees inside DWP.

**Current knowledge in the research field.** GameBus is a personalized health oriented gamification platform that encourages and rewards players to stay healthy in a personalized gaming experience (GameBus, 2017). It focuses on engaging people with different health interests and different capabilities into shared health competitions, which GameBus defines as Unified Health Gamification (UHG) (Shahrestani et al., 2017). Gamification is focusing on the combination of playing, thinking and doing such that information, knowledge and skills can be transferred to the user. It gives the user a sense of control which will enhance motivation and engagement among the users (Warner, 2016). A new development in gamification is the design of ‘personalized and contextual experiences’ in which gamification should be seen from a highly-personalized perspective. This new way of gamification touches precisely on the growing interest in ‘personalized health’ which provides personalized interventions that are focused on the specific needs of an individual patient (McCallum, 2012).

**Using GameBus as a motivator to comply to treatment.** Different GameBus challenges have been designed in order to be able to answer the first main research question. These designs were varying in terms of non-unified versus unified design and non-personalized versus personalized design. These designs were implemented in a small pilot study which had the goal to find out which design of GameBus achieved the highest motivation to comply to treatment inside DWP. It used an iterative testing procedure in which GameBus was adapted on the basis of actual the responses of the pilot participants accompanied with small questionnaires and personal data. The results showed that a personalized design achieved the highest motivation to comply to treatment and the highest levels of perceived fairness and fun. The most important reasons for these findings were that the users experienced a higher fit to personal needs, more equality in terms of opportunity to win and a higher perceived level of fun since the personalized design increased the sense of mastery, choice, fair competition and personal identity more than the non-personalized design. These findings were in line with earlier research that were investigating the promoters of perceived fun (Ventrice, 2011). In addition to that, it was found that the client population is very diverse and therefore, an ‘one fits all’ design is not appropriate inside DWP. These findings are in line with the current developments in gamification design that are focusing more and more on the personalized gaming experiences. This research contributed to this research field by showing that adding user-centered, personalized and adaptive game mechanisms, adjusted to the characteristics of a specific user and the contexts is improving the user experiences.

However, personalization in this setting can be done in two ways, namely: personalization in terms of activities and personalization in terms of scoring systems. Personalization in terms of activities was covered during the pilot study, but the personalization in terms of smart scoring systems was not yet implemented in the pilot study. Evaluations with both clients and employees showed that they perceived the adaptation of scoring systems on the basis of personal characteristics as very valuable inside DWP. So in conclusion, the pilot showed very positive results for using GameBus as a motivating and monitoring app and, additionally, there is a great need for personalized challenges. This led to the development of a decision support tool for employees in which they can create these personalized challenges with the usage of different client characteristics.

**Using a decision support tool for putting the HKT-app into practice.** The decision tool that was developed will be used to support an employee inside DWP in deciding which activities and which



scoring systems should be used in a personalized challenge in GameBus. It is using 3 different types of data in the data management component, namely: personal data, activity type data and activity specific data. One of the most important data sources on the personal level are the HKT-scores of a client. These scores will be used for both the activity recommendation and scoring system recommendation. Since these HKT-scores are used, the tool and consequently the GameBus challenges are supporting the employee in translating the HKT-app to a practical daily level. It is helping them to make the next step from only filling in the HKT-app and discussing these scores with the client to applying the HKT-app during their daily work routine. This will thus decrease the confusion among employees and clients about how the HKT-app can be best applied in their daily routines.

The prototype of this tool was evaluated with several employees which all indicated that they find it very useful, understandable and valuable inside DWP. However, the implementation step was not performed in this master thesis since this was left out of scope due to time constraints.

**Recommendations and future work.** The promising results of both the pilot and the prototype design showed that future research should continue with improving and implementing the tool and GameBus such that it is possible to put the personalized challenges into practice. The positive results showed that there are promising future investigations for both DWP, the decision support tool and GameBus.

Firstly, DWP should continue with a GameBus pilot on a larger scale that uses the personalized challenges that were proposed in this master thesis. Future research thus could focus on the implementation of the tool with a larger pilot group over a longer period. When this would be done, the results of the personalization of challenges in terms of motivational effects and perceived fairness and fun would be more robust. Secondly, the decision support tool could be expanded to other departments or health institutions that are also looking for interventions that would increase the motivation to comply to treatment. Besides that, future research should also focus on extension of the decision support tool in terms of important input and output variables. Lastly, different improvement points for GameBus were mentioned by both employees and clients as well. These improvement points can be divided in the improvement of the usability of GameBus in general and the improvement of the current scoring systems of GameBus. GameBus should take these different recommendations into consideration to improve the app. Implementing these improvements would increase the usability of GameBus as a motivating and monitoring app for healthcare organizations.

**Final remark.** In conclusion, this master thesis investigated the role of GameBus inside the forensic psychiatric healthcare sector. It researched how GameBus could be brought closer to the needs of DWP. This was done by investigating which design practices inside GameBus were most appreciated by the clients and employees of DWP and by further expanding this design set-up by the development of a decision support tool. Before this master thesis was started, the goals of GameBus and DWP seemed to be misaligned since on the one hand, GameBus is focusing on encouragement of its users to stay healthy on a social, mental and physical level. The goal of DWP on the other hand is to motivate clients to comply to treatments agreements. However, the at first apparent different goals of both GameBus and DWP could be aligned by using GameBus as a motivator to perform the activities that matter to DWP. The promising results of his study showed that GameBus can be very valuable for different types of organizations and different types of desired goals. In addition to that, DWP now has a practical tool that can solve the problems that both the employees and clients are facing concerning the usage of the HKT-app on a daily level and with regard to the low motivation to comply to treatment. Therefore, they should continue with the development and improvement of the GameBus challenges in the future such that it can be actually applied in practice by DWP.

## List of figures

|   |     |
|---|-----|
| Figure 1. Yearly costs of diseases in the Netherlands per diagnosis type (RIVM, 2013a).....   | 1   |
| Figure 2. Screenshots of GameBus.....   | 5   |
| Figure 3. Screenshot of a filled in HKT-R Zelfscore Spin.....                                 | 6   |
| Figure 4. Goal alignment GameBus and DWP.....   | 7   |
| Figure 5. The Game Element Hierarchy (Werbach & Hunter, 2012).....                            | 10  |
| Figure 6. The adapted regulative cycle.....   | 15  |
| Figure 7. Overview master thesis process.....   | 18  |
| Figure 8. Timeline pilot study.....   | 20  |
| Figure 9. Process for MCID calculation.....   | 24  |
| Figure 10. Possible conclusions based on CI's and MCID (Man-Son-Hing et al., 2002).....       | 25  |
| Figure 11. Percentage of responded frequencies of HKT-app usage among interviewed employees.. | 26  |
| Figure 12. Degree of treatment compliance from the employees' point of view.....              | 27  |
| Figure 13. Motivation to comply to treatment at the start of the pilot.....                   | 28  |
| Figure 14. Fishbone diagram of problem.....   | 28  |
| Figure 15. Overview of the different tested designs.....                                      | 39  |
| Figure 16. CI 95% and MCID for 'fun'.....   | 44  |
| Figure 17. CI 95% and MCID for 'fairness'.....  | 45  |
| Figure 18. CI 95% and MCID for 'autonomy'.....  | 48  |
| Figure 19. CI 95% and MCID for 'competence'.....  | 48  |
| Figure 20. CI 95% and MCID for 'intrinsic motivation'.....                                    | 49  |
| Figure 21. CI 95% and MCID for 'identified regulation'.....                                   | 49  |
| Figure 22. Mean activity level per pilot participant before and during pilot.....             | 51  |
| Figure 23. Future improvements for GameBus inside DWP.....                                    | 53  |
| Figure 24. Decision tree personas creation.....   | 56  |
| Figure 25. Extended decision tree personas creation.....                                      | 57  |
| Figure 26. Development process decision support tool.....                                     | 59  |
| Figure 27. Structure decision support tool.....   | 61  |
| Figure 28. Prototype GameBus challenge decision support tool.....                             | 68  |
| Figure 29. Process implementation decision support tool.....                                  | 70  |
| Figure 30. Framework literature review.....   | 92  |
| Figure 31. Planning master thesis project.....  | 104 |
| Figure 32. Process GameBus challenge design.....  | 105 |
| Figure 33. Visual representation increasing scoring system.....                               | 108 |
| Figure 34. Visual representation decreasing scoring system.....                               | 108 |
| Figure 35. Visual representation baseline improvement scoring system.....                     | 108 |

|  |     |
|--|-----|
| Figure 36. Visual representation limit scoring system.....                 | 109 |
| Figure 37. Visual representation goal completion scoring system. ....      | 109 |
| Figure 38. Visual representation HKT-adjustment scoring system. ....       | 109 |
| Figure 39. Visual representation adjusted leaderboard scoring system. .... | 110 |
| Figure 40. Personas based on pilot.....                                    | 124 |
| Figure 41. Decision tree start. ....                                       | 141 |
| Figure 42. Decision tree hospitalization phase. ....                       | 142 |
| Figure 43. Decision tree treatment phase.....                              | 143 |
| Figure 44. Decision tree resocialization phase.....                        | 144 |

## List of tables

|  |     |
|--|-----|
| Table 1. Demographics of the participants. ....                                  | 19  |
| Table 2. Overview of outcome measures and the corresponding constructs. ....     | 24  |
| Table 3. Frequency of HKT-app usage among clients.....                           | 27  |
| Table 4. Design parameters in GameBus.....                                       | 30  |
| Table 5. Overview scoring values GameBus challenge.....                          | 35  |
| Table 6. Overview of investigated scoring systems.....                           | 37  |
| Table 7. Overview design parameters per design type. ....                        | 38  |
| Table 8. MCID calculation for the Fun questionnaire. ....                        | 44  |
| Table 9. MCID calculation for the Fairness questionnaire. ....                   | 45  |
| Table 10. Decision table for best design. ....                                   | 46  |
| Table 11. MCID calculation for the Self-Determination Theory questionnaire. .... | 47  |
| Table 12. MCID calculations for the Motivation questionnaire. ....               | 48  |
| Table 13. Overview tested hypotheses regarding SDT and motivation.....           | 49  |
| Table 14. Again-again matrix GameBus.....  | 50  |
| Table 15. Client preferences for scoring systems. ....                           | 54  |
| Table 16. Employee preferences for scoring systems. ....                         | 58  |
| Table 17. Input and output decision support tool.....                            | 61  |
| Table 18. Overview scoring systems for activities and personas.....              | 64  |
| Table 19. Example scoring systems.....   | 67  |
| Table 20. Example of output decision tool for persona 'Gregory'.....             | 69  |
| Table 21. Evaluation decision support tool.....                                  | 71  |
| Table 22. Description of each risk factor.....                                   | 87  |
| Table 23. Description of the game dynamics.....                                  | 88  |
| Table 24. Description of the game mechanics. ....                                | 88  |
| Table 25. Description of the game components.....                                | 88  |
| Table 26. Search queries literature review.....                                  | 89  |
| Table 27. Articles retrieved from search queries. ....                           | 89  |
| Table 28. Citation chase results. ....   | 90  |
| Table 29. Overview of goals used in gamification for health.....                 | 92  |
| Table 30. Overview of game dynamics used in gamification for health.....         | 93  |
| Table 31. Overview of game mechanics used in gamification for health.....        | 93  |
| Table 32. Overview of game components used in gamification for health.....       | 93  |
| Table 33. Activities per risk factor.....  | 106 |
| Table 34. Decision table activities for GameBus challenge. ....                  | 107 |
| Table 35. Template decision table for best design.....                           | 111 |

|   |     |
|---|-----|
| Table 36. Cronbach's alpha values.....                            | 118 |
| Table 37. Shapiro-Wilk test values. ....                          | 118 |
| Table 38. Paired Samples Statistics for 'SDT'.....                | 119 |
| Table 39. Paired Samples Test for 'SDT'. ....                     | 119 |
| Table 40. Paired Samples Statistics for 'Motivation'.....         | 119 |
| Table 41. Paired Samples Test for 'Motivation'. ....              | 119 |
| Table 42. Paired Samples Statistics for 'Fun'. ....               | 119 |
| Table 43. Paired Samples Test for 'Fun'.....                      | 120 |
| Table 44. Paired Samples Statistics for 'Fairness'.....           | 120 |
| Table 45. Paired Samples Test for 'Fairness'. ....                | 120 |
| Table 46. Nodes overview with references from interview. ....     | 121 |
| Table 47. Characteristics pilot participants.....                 | 123 |
| Table 48. Employee evaluation of scoring systems.....             | 134 |
| Table 49. Hospitalization planning personality. ....              | 136 |
| Table 50. Hospitalization planning psychosis.....                 | 136 |
| Table 51. Weightings for activities per HKT risk factor. ....     | 137 |
| Table 52. Scoring systems for care path psychosis.....            | 138 |
| Table 53. Scoring systems for care path personality.....          | 138 |
| Table 54. Results testing decision support tool per persona. .... | 145 |

## List of abbreviations

|          |   |
|----------|---|
| ACSM/AHA | American College of Sports Medicine and the American Heart Association        |
| ADL      | Algemene Dagelijkse Levensverrichtingen (General Daily Activities)            |
| BDL      | Bijzondere Dagelijkse Levensverrichtingen (Special Daily Activities)          |
| CI 95%   | 95% Confidence Intervals  |
| DWP      | De Woenselse Poort  |
| GGZ      | Geestelijke Gezondheidszorg (Association of Mental Health and Addiction Care) |
| GGzE     | Geestelijke Gezondheidszorg Eindhoven   |
| HKT-app  | Self-score app to assess HKT-R scores   |
| HKT-R    | Historical, Clinical, Future – Revised  |
| MCID     | Minimal Clinically Importance Difference                                      |
| SDT      | Self-Determination Theory   |
| SIMS     | Situational Motivation Scale  |
| UDL      | Universal Design for Learning   |
| UHG      | Unified Health Gamification   |
| WHO      | World Health Organization   |

## Table of contents

|   |     |
|---|-----|
| Preface .....   | i   |
| Executive summary .....   | ii  |
| List of figures .....   | v   |
| List of tables .....  | vii |
| List of abbreviations .....   | ix  |
| 1. Introduction .....   | 1   |
| 1.1. Current challenges in the Dutch mental healthcare sector ..... | 1   |
| 1.2. Gamification as a solution to the current challenges .....     | 2   |
| 1.3. Context .....  | 3   |
| 1.4. Current situation .....  | 6   |
| 1.5. Research objectives .....                                      | 8   |
| 1.6. Scientific and practical relevance .....                       | 8   |
| 1.7. Structure master thesis .....                                  | 9   |
| 2. Current knowledge in gamification for health .....               | 10  |
| 2.1. eHealth and gamification .....                                 | 10  |
| 2.2. Gamification for (mental) health .....                         | 11  |
| 2.3. Motivation theory .....  | 12  |
| 2.4. Conclusion & discussion .....                                  | 13  |
| 3. Methodology .....  | 14  |
| 3.1. Problem statement .....  | 14  |
| 3.2. Research questions .....                                       | 14  |
| 3.3. Research process .....   | 18  |
| 3.4. Pilot .....  | 19  |
| 3.5. Preparations for the quantitative evaluations .....            | 23  |
| 4. Diagnosis .....  | 26  |
| 4.1. Current obstacles .....  | 26  |
| 4.2. Successful gamification design .....                           | 29  |
| 5. Design .....   | 33  |
| 5.1. First basic challenge decisions .....                          | 33  |
| 5.2. Design types .....   | 35  |
| 5.3. Design checklist .....   | 37  |

|      |  |     |
|------|--|-----|
| 6.   | Implementation .....   | 40  |
| 6.1. | Non-unified versus unified design.....                                     | 40  |
| 6.2. | Personalized design .....  | 42  |
| 6.3. | GameBus experience in general .....  | 46  |
| 6.4. | Conclusion and discussion .....  | 51  |
| 7.   | Evaluation .....   | 53  |
| 7.1. | Improvements to GameBus .....  | 53  |
| 7.2. | Evaluation of smart scoring systems .....                                  | 54  |
| 7.3. | Discussion results .....   | 58  |
| 7.4. | Conclusion and discussion .....  | 59  |
| 8.   | Decision support tool .....  | 60  |
| 8.1. | Construction of decision support tool.....                                 | 60  |
| 8.2. | Requirements and constraints.....  | 60  |
| 8.3. | Data management .....  | 61  |
| 8.4. | Model management .....   | 63  |
| 8.5. | User interface management .....  | 66  |
| 8.6. | Testing the decision support tool.....                                     | 68  |
| 8.7. | Putting the decision support tool into practice .....                      | 69  |
| 8.8. | Evaluation decision support tool .....                                     | 70  |
| 9.   | Conclusion & discussion.....   | 72  |
| 9.1. | Recommendations and future work.....                                       | 73  |
| 9.2. | Reflection on methodology .....  | 75  |
| 9.3. | Final remark.....  | 75  |
|      | Bibliography .....   | 76  |
|      | Appendices.....  | 84  |
|      | List of figures in appendices .....  | 85  |
|      | List of tables in appendices.....  | 86  |
|      | Appendix A. Description of the clinical risk factors of the HKT-R .....    | 87  |
|      | Appendix B. Description of the Game Element Hierarchy.....                 | 88  |
|      | Appendix C. Literature review.....   | 89  |
|      | Appendix D. Pre-test questionnaire .....                                   | 95  |
|      | Appendix E. Intermediate interview: Non-unified versus unified design..... | 99  |
|      | Appendix F. Post-test questionnaire and interview.....                     | 101 |
|      | Appendix G. Planning.....  | 104 |



|  |     |
|--|-----|
| Appendix H. Screenshots GameBus for design space definition.....                 | 105 |
| Appendix I. Decision table activities based on HKT .....                         | 106 |
| Appendix J. Decision table activities for GameBus challenge .....                | 107 |
| Appendix K. Visual representation smart scoring systems .....                    | 108 |
| Appendix L. Template decision table.....   | 111 |
| Appendix M. Screenshots GameBus challenges .....                                 | 112 |
| Appendix N. Reliability of scales and normality test .....                       | 118 |
| Appendix O. Results paired t-tests.....  | 119 |
| Appendix P. Coding scheme of interviews.....                                     | 121 |
| Appendix Q. Personas creation.....   | 123 |
| Appendix R. Developed personas for evaluation of scoring systems. ....           | 124 |
| Appendix S. Post-test smart scoring systems for employees .....                  | 125 |
| Appendix T. Evaluations scoring systems by employees .....                       | 134 |
| Appendix U. Overview hospitalization planning.....                               | 136 |
| Appendix V. Weightings activities for HKT-scores .....                           | 137 |
| Appendix W. Decision tables recommended and default values scoring systems ..... | 138 |
| Appendix X. Quick design decision support tool.....                              | 141 |
| Appendix Y. Results testing decision support tool.....                           | 145 |
| Appendix Z. Typed and coded interviews .....                                     | 147 |

## **PART 1**

### **INTRODUCTION TO RESEARCH AREA**

This master thesis is investigating the implementation of personalized gamification in the forensic mental healthcare sector. It is researching the best design practices for achieving client motivation to comply to treatment agreements. In addition to that, it will develop a decision support tool for the employees that will guide them in the development of personalized gamification. These two objectives are investigated by answering several research questions. Before these research questions will be discussed it is important to get a general understanding of the research field.

Therefore, an introduction to the research will be given in this part. It starts with describing the current challenges in the research field and will continue with the context of this master thesis. Afterwards the results from a literature review regarding the current knowledge in gamification for health and motivational theory are summarized.

# 1. Introduction

This chapter describes the central issue of concern for this master thesis. It will start with describing the current challenges in the Dutch mental healthcare sector and will continue with describing gamification as a solution for the challenges the Dutch mental healthcare is facing.

## 1.1. Current challenges in the Dutch mental healthcare sector

The costs of the healthcare sector in the Netherlands keep on rising. In 2015, the total expenditures on health in the Netherlands were equal to 95 billion euros which is equal to 5,628 euros per inhabitant. This means that an average Dutch family is spending 23 percent of their income on care. When nothing will change in the future, this will increase to 36 percent in 2040 (Ewijk et al., 2013). When these expenditures are subdivided per assignable diagnosis type, which is shown in Figure 1, the largest part of the Dutch health expenditures is spent on mental disorders.

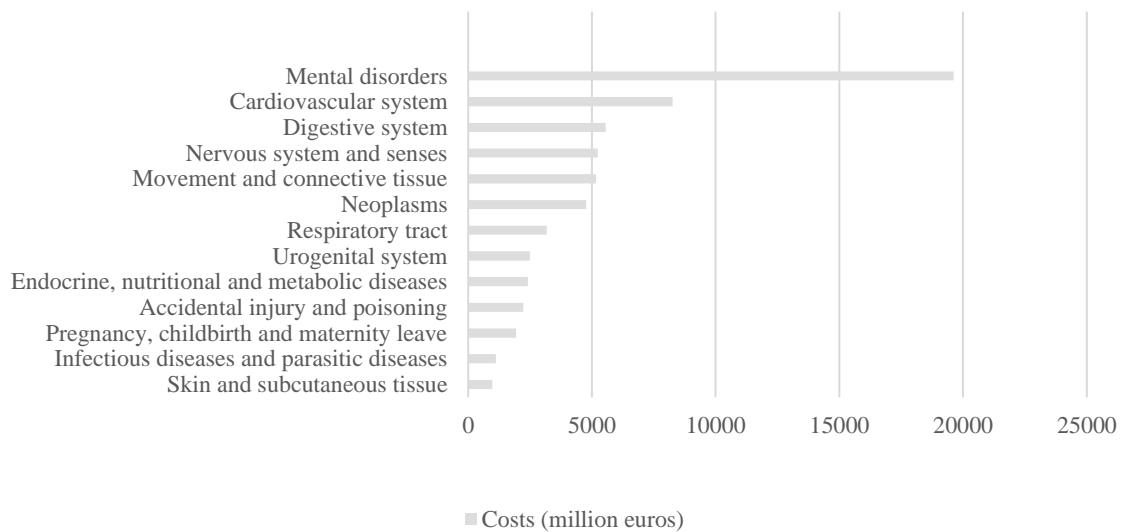


Figure 1. Yearly costs of diseases in the Netherlands per diagnosis type (RIVM, 2013a).

An important part of the mental healthcare sector is the forensic mental health services sector. This sector provides individuals with a mental disorder who pose, or have posed, risks to others and that risk is usually related to their mental disorder. Forensic mental health services are so called ‘low volume and high cost’ services which means that the forensic mental health services provide care to a smaller number of individuals with more complex problems. This results in higher related healthcare costs for this group of patients (JCPMH, 2013). Currently, mental disorders and distress can be treated in different sectors, such as the GGZ (Association of Mental Health and Addiction Care), primary care and hospital care. The GGZ sector is taking up 80% of the total mental health expenditures in the Netherlands (RIVM, 2013b). The government and the employers’ organization GGZ Nederland (Dutch Association of Mental Health and Addiction Care) made appointments in 2012 that should lead to a reduction in costs (GGZnieuws.nl, 2014).

In order to be able to provide the right solution for the rising costs, it is important to understand the determinants of the large proportion of mental health expenditures in the GGZ in the Netherlands. The most important determinant of the increasing costs is an increase in demand for mental health services. Although the amount of psychological disorders in the Netherlands is not increasing, the demand for GGZ is increasing. This increase is caused by two reasons. First of all, because of the increased accessibility of the sector and a decreased taboo around mental disorders more people appeal to the mental health services when they experience mental health problems. Secondly, the general practitioner is diagnosing more patients with mental health problems. The number of diagnosed patients

by the general practitioner was equal to 13,180 in 2005, while this amount was equal to 26,620 in 2010 (Bijenhof et al., 2012). It might sound contradictory that although it is not observed that the amount of people with mental disorders did not increase, the amount of diagnosed people with mental disorders did increase. The reason for this increase in diagnosed patients by the general practitioner is because there is an increased collaboration between the general practitioner and social work providers which in turn is increasing the involvement of general practitioners in patients with mental disorders (Bijenhof et al., 2012).

The (mental) healthcare sector is known for its complex nature and culture which is under high pressure in terms of regulations, cost savings, workload and patient expectations. This leads to the case in which new innovations are often postponed and most attention is given to the day-to-day patient care (Grajewski, 2015). However, innovating in healthcare is an evolution that cannot be ignored. Without innovation, the Dutch healthcare system will not be able to deliver care to the increasing number of patients in the future at a fair price (Van der Horst & Ter Rele, 2013). One of these possible innovations is the application of gamification in healthcare. This promising solution is discussed below.

## **1.2. Gamification as a solution to the current challenges**

Different innovations are possible such as the development of new medical equipment, process innovations and the use of eHealth (NVZ, 2014). EHealth, and more specifically e-Mental Health, is a very relevant development that can provide a solution for the increasing amount of people that are in need for mental health services and for the rising healthcare expenditures. E-Mental Health is the use of information and communication technology for the support or improvement of mental health and mental healthcare (Cotton et al., 2013). It is about interventions focusing directly on the mental well-being of the patients that respond to today's challenges, such as the growing demand for mental healthcare and rising costs. At the same time, it can increase the number of people in reach of mental healthcare and thus decrease the treatment gap. A current development in the Dutch mental healthcare sector is the use of gamification as a form of e-Mental Health (GGZNederland, 2013). The term 'gamification' means using game design elements and game-design techniques in non-gaming contexts to improve user experience and user engagement (Deterding et al., 2011).

Some good examples of applications that are using gamification to promote healthy behavior are Reflexion Health, Monster Guard and Leapband. The first one uses video feedback systems to correct the movements of patients that practice physical therapy based exercises. The movements are modelled by animated figures that gives guidance and correction suggestions. The second app is focusing on helping prepare children for emergencies. It teaches kids through 'Monster Guard Academy' how to prepare and stay safe during home fires, hurricanes, floods or other disasters, and they get points and medals for completing tasks. The latter encourages kids to stay on the move. They can earn coins to redeem for agreed-upon rewards while parents can monitor their kids (TMF, 2017). As one can see from these examples, the opportunities are infinite when one wants to deploy gamification in healthcare.

There are valid reasons for the growing interest in the usage of gamification for stimulating behavioral change in mental healthcare. Firstly, within gamification there is the possibility to give real-time feedback to the users, it increases knowledge in an interactive way and it can create a virtual world with the perfect balance between treatment and play (Cook, 2003). It gives the possibility to empower the users and stimulate them to change their behavior which will improve their health (Warner, 2016).

Early gamification initiatives were merely focusing on so called 'game play-driven experiences' in which the goal was to provide an enjoyable experience for the users. However, the current developments in gamification are much more focused on so called 'personalized and contextual experiences' in which gamification should be seen from a highly-personalized perspective (Böckle et al., 2017). It should adapt to each participant's situation such that it is in line with their personality, emotions, habits and activities. This is the so-called 'Gamification 3.0' (Gadiyar, 2014). This new way

of gamification touches precisely on the growing interest in ‘personalized health’ which provides personalized interventions that are focused on the specific needs of an individual patient (McCallum, 2012).

So, when personalized gamification will be used to stimulate personalized health, it will place each client in the center of attention. This will contribute to an increase in the quality of care and a decrease of costs at the same time which is of great value for the mental healthcare sector (Teng, 2012). The costs will decrease because of improved efficiency, reduced health disparities and an improved population health (Chen et al., 2016). However, little is known yet on how to effectively personalize gamification in the mental healthcare while still providing the enjoyable experience for the users. In-depth study and evaluation of the potential of gamification to change health behavior is needed to make sure the gamification implementation is not doomed to fail due to poor alignment with the user needs (Lister et al., 2014). This research will contribute to this knowledge by investigating the usage of personalized gamification in the forensic mental health services sector. More specifically, it will investigate the usage and best design practices of a health gamification app (GameBus) in a Dutch forensic psychiatric hospital (‘De Woenselse Poort’). These stakeholders of this research will be described in detail in the next section.

The remainder of this chapter is organized as follows: first, the context of the graduation project is described. Afterwards, the perceived current situation inside DWP is outlined which is followed by the research objective that is derived from the problems that DWP is facing. Subsequently, the scientific and practical relevance of this master thesis project is described and the chapter will close with discussing the complete thesis outline.

### **1.3. Context**

This graduation project was investigating the user perceptions of different designs of ‘GameBus’ that are focused on stimulating clients in ‘De Woenselse Poort’ to comply to their treatment based on their HKT-app scores. These three concepts will be discussed below before going any further with explaining the problem description and research questions.

#### **1.3.1. GGzE – De Woenselse Poort**

This master thesis was conducted at ‘De Woenselse Poort’ (DWP). DWP is the forensic psychiatric department of the GGzE (GGZ Eindhoven) and provides forensic care for psychiatric clients in both inpatient and outpatient forms. The clients that stay in DWP are there either because of a criminal title or because of a civil action. Their detainment order is aimed at treating the individual and protecting society.

DWP has two main departments which can be divided in sixteen different clinical sub-departments. In which department a client is placed depends on their psychiatric conditions, treatment goals, treatment phase and the care path (diagnosis) of the client. In addition to that, the security needs and the intensity of the treatment will determine the department as well. There are two types of care paths that are treated inside DWP, these are: 1) personality disorder and 2) psychosis, mental disorder and autism (DWP, 2017). These care paths are established by Trimbos who developed the basic care paths for the Association of Mental Health and Addiction Care in the Netherlands (Trimbos, 2017).

In general, there are 4 security levels possible in forensic psychiatric hospitals. DWP knows two types of security levels, namely level 2 and level 3. Level 2 is called ‘Poort’ and level 3 is called ‘Woensel’. Both security levels have 8 departments and each security level has its own courtyard. Besides security levels 2 and 3, there are two different security levels (level 1 and 4). Level 1 is the applicable to resocialization residentials and level 4 is the highest possible security level. The reason why level 1 and 4 are not present inside DWP is because the security rules inside DWP do not apply to these levels. Level 1 needs less security while level 4 needs more security. Level 2 is an average security

level in which there are security agreements with the clients and their drug abuse is monitored. It is a closed environment which clients cannot exit or enter freely. However, if they have certain liberties they have the possibility to leave the institution for a short amount of time. Level 3 is a high security level to which strict security measures in a closed environment apply. Activities outside the closed environment are very rare (Ministerie van Veiligheid en Justitie, 2016).

Both male and female clients are residing in DWP. DWP currently takes care of 193 clients (18-09-2016) from which 82% has a forensic title based on the Code and Criminal Law. DWP has a total of 281 employees, which can perform a range of functions. Some examples of function groups are: (nursing) supervisors, therapists, trainers, experience experts and security officers (Inspectie Veiligheid en Justitie, 2017). The ratio of employees versus clients already indicate that there is a high number of employees in comparison to clients. This is in line with the earlier mentioned ‘low volume, high costs’ services since there is a relatively small number of clients in comparison to the expenditures in terms of employee costs.

The clients that are living in ‘Woensel’ are mainly concerned with performing activities that are part of their treatment plan. Examples of such activities are following therapies, training, education blocks, labor blocks and sport blocks. On the other hand, clients that are living in ‘Poort’ are more concerned with performing activities that are focusing on resocialization. The amount of therapies, training, education blocks, labor blocks and sport blocks inside DWP are decreasing. Instead of those activities, they are more focusing on returning to society, developing structure in their daily lives and they have a higher responsibility for keeping appointments inside DWP. Some example activities are: building a positive social network, arranging finances and working on future steps such as looking for education opportunities or work opportunities (M. Bankers, personal communication, April 15, 2017).

### **1.3.2. GameBus**

GameBus is an eHealth application that is developed by the IE&IS faculty of the Eindhoven University of Technology. The mission statement of GameBus reads as follows: ‘GameBus is a platform that encourages and rewards families and friends to stay active socially, mentally and physically in a personalized gaming experience. GameBus enables people to perform the activities they enjoy truly as an individual in such a way that they are part of an integrated social interaction’ (GameBus, 2017). This novel approach to gamification is defined as Unified Health Gamification (UHG) which is about the capability to engage people with different health interests and different capabilities into shared health competitions (Shahrestani et al., 2017). GameBus gives the opportunity to build your own team, play together and win rewards based on your performance.

The World Health Organization (WHO) defines health as ‘a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity’ (World Health Organization, 1995). The strength of GameBus is that it is the only app that is stimulating activities in all those three categories. In addition to that, because of the opportunity to build your own team, create your own custom challenges, play together and win rewards it is an app that is creating a personalized gaming experience. Therefore, GameBus can be seen as a personalized health related gamified application.

GameBus works with so called ‘challenges’. These challenges consist of different activities that the users can perform and for which they can earn points. The collected points will be shown on a leaderboard that presents the current positions of each player. For each challenge, the creator of the challenge must decide which activities are included, how many points are rewarded for each activity, how the winner(s) is/are determined and what reward the winner(s) get. In Figure 2 some screenshots of GameBus are given to get a general understanding of the app. The first screenshot shows how a leaderboard looks like, the second screenshot shows the menu in which a user can select the activity for which he or she wishes to register points. Lastly, a monthly overview can be showed in which a user can see which type of activities he or she has performed on which days. These screenshots do not

provide the complete collection of possible screens and options inside GameBus, but they provide a decent overview of how the app looks like.

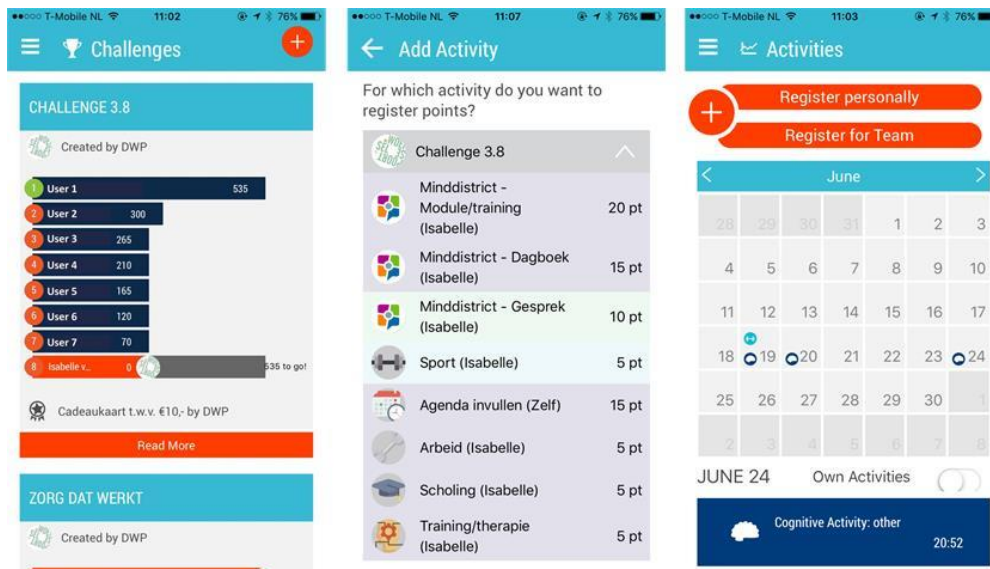


Figure 2. Screenshots of GameBus.

A great benefit that GameBus offers is the possibility to connect GameBus with other existing applications. In this way, the user can combine information from all kind of applications into one score in GameBus. This gives the possibility for health institutions such as DWP to stimulate their clients to use eHealth applications during their treatment. In addition to that, it can stimulate the clients to comply to agreements that are made regarding the activities they should perform on a daily basis, such as following therapies and sport blocks.

### 1.3.3. HKT-R Selfscoring Tool (HKT-R Zelfscore Spin)

The HKT-app is an eHealth application that is derived from a risk assessment instrument (HKT-R) that can determine which risk factors need to be improved and which risk factors are already improved. Before getting into too much detail about the HKT-app, a short description about the risk assessment instrument is given.

HKT-R stands for Historical, Clinical and Future – Revised and is a revised successor of the HKT-30. It is a structured professional risk taxation instrument to support the clinically weighted final judgement on the risk of violent recidivism of forensic psychiatric patients. It contains 33 indicators of which 12 are historical, 14 clinical and 7 future indicators. The historical indicators relate to the life history until the arrest for the current offense. The clinical indicators are about the behavior of the client in the 12 months prior to the risk taxation. The future indicators refer to the estimation of the risks that may occur when there is leave, extension of leave, transfer to a follow-up institution and/or when a patient will resocialize instantly without supervision (Spren et al., 2014).

The HKT-app is designed specifically for patient in DWP and is focusing on both clinical and future indicators. This master thesis will focus on the clinical indicators, since these are the indicators that are of importance for treating the client inside DWP. This resulted in the decision to include only that part of the application. An example of a filled in ‘HKT-R Zelfscore Spin’ accompanied with the English translations is shown in Figure 3. The items that are used in the app are: influenceability, labor skill, appointments, coping skills, responsibility, treatment readiness, self-reliance, social behavior, hostility, antisocial behavior, impulsiveness, addiction, psychoses and problem understanding. An explanation of each of these risk factors is given in Appendix A. The red flag means that the item is still

a risk factor and the green thumb means that the item is a protected factor. The red dot means that a client wants a lot of help with the risk factor, the orange dot means that they want a little bit of help and the green dot means that no help is needed. The blue dot shows the current score of the risk factor. The closer the blue dot is to the middle, the better the client is scoring on that risk factor. When a risk factor is under control the risk factor will turn blue and the middle circle will show a blue wedge.

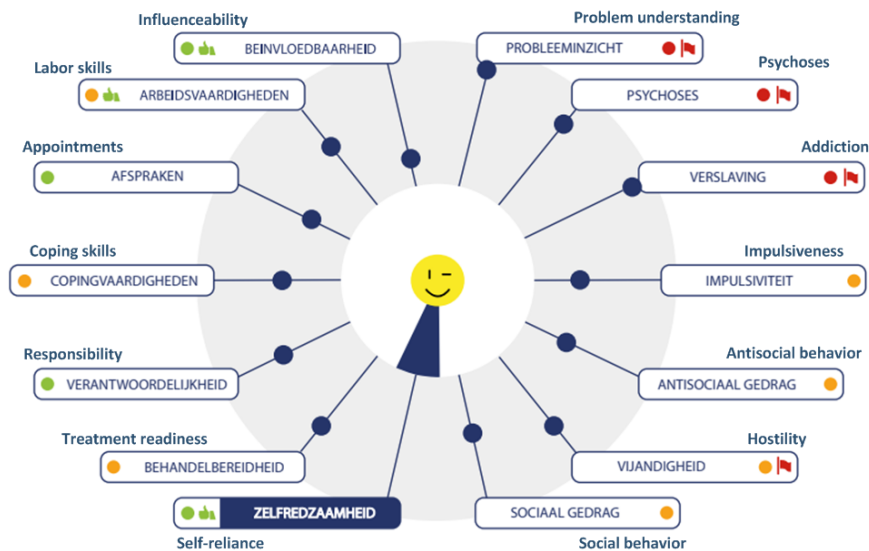


Figure 3. Screenshot of a filled in HKT-R Zelfscore Spin.

Every 6 months the healthcare team together with the client will look at the HKT-app during the discussion of the care plan. Both parties will fill in the HKT-app such that they both have a personal rating of the risk factors which they in turn can compare and discuss. The 14 risk factors will be evaluated on the basis of which risk factors are improving and which risk factors still need support. The HKT-app will support the empowerment of the clients by giving them the possibility to discuss their own view on their functioning with the healthcare team and comparing that with the view of the healthcare team. It provides the possibility for a client to monitor his or her own improvements and to set goals for the future. It is an objective tool to use in the treatment decision conversations between a client and the care provider (Zorginzicht, 2017).

#### 1.4. Current situation

DWP has set a target for 2017 that stated that eHealth should be implemented such that in 15/20% of a client's treatment eHealth applications should be applied. They believe that eHealth can have major contributions in which the client can have a sense of empowerment, control and involvement in their own health, safety and recovery (DWP, 2017). An example besides the HKT-app of an eHealth application that DWP is using is Minddistrict. Minddistrict is an online treatment platform that provides eHealth solutions to the healthcare sector by following personal routes to change. A client can perform different types of modules, trainings and diaries which are related to a certain risk factor. It supports personal recovery by means of technology that ranges from prevention to aftercare. This ensures that the care that is provided is in line with the personal needs (Minddistrict, 2017).

There are various reasons why DWP wants to increase the usage of eHealth. First, they want to deepen and accelerate the treatment of the clients because eHealth makes it possible for a client to work on their own treatment in their own time. Secondly, DWP wants to support self-management and participation of the clients within a safe framework. They can determine personally which eHealth applications they wish to use. Lastly, the usage of so-called blended care (the combination of face-to-face conversations and online treatment) can decrease the total amount of face-to-face contact between



client and caregiver. This will lead to a decrease in costs per client and an increase in the number of clients a caregiver can treat in the same amount of time (DWP, 2016).

The progressive look regarding eHealth of DWP has led to the development of the HKT-app. The HKT-app that is described above is a joint project of DWP and ‘De Pompestichting’ and is applied in DWP since January 2016. ‘De Pompestichting’ is another forensic psychiatric clinic in the Netherlands. The HKT-app provides added value and objectivity for the care plan conversation between client and therapist during which it is determined on which goals the client will work in the upcoming period. So in other words, it is a concrete guidance on which decisions can be based regarding the treatment of the client (Zorginzicht, 2017).

Although the HKT-app provides the possibility to make operational decisions regarding the treatment of a client, it is perceived that this step is not yet executed inside DWP. They have achieved individual successes regarding the usage of the HKT-app, but they have not yet succeeded in effecting organizational changes. The reason for this is that there is still much confusion among employees and clients about how the HKT-app can be best applied in their daily schedule. In other words, when the HKT-app is filled in by both the employee and client, they don’t know how this can be translated to the daily treatment level. These uncertainties lead to a low motivation of both employees and clients to apply the HKT-app in the client’s treatment. Besides that, most of the clients inside DWP have a low motivation to comply to their treatment activities in general. This is a cause of concern, because non-compliance negatively effects both the desirable clinical and economic outcomes (Jin et al., 2008). As stated above, gamification can be used to empower and motivate the clients in DWP. GameBus can provide support to clients by delivering an application that will motivate and monitor them throughout their entire treatment. To be able to achieve this goal, a research should be conducted on how to design GameBus in such a way that it will enhance and accelerate the treatment of the clients in DWP based on their HKT-scores. In addition to that, it should be investigated how employees and clients inside DWP can be supported in applying the HKT-app in their daily routines. This will increase the usability of the HKT-app in daily operational decision-making procedures. In this way, it is possible to align the current goal of GameBus with the goal that DWP wants to achieve. When this goal alignment is visualized, it would look as follows.

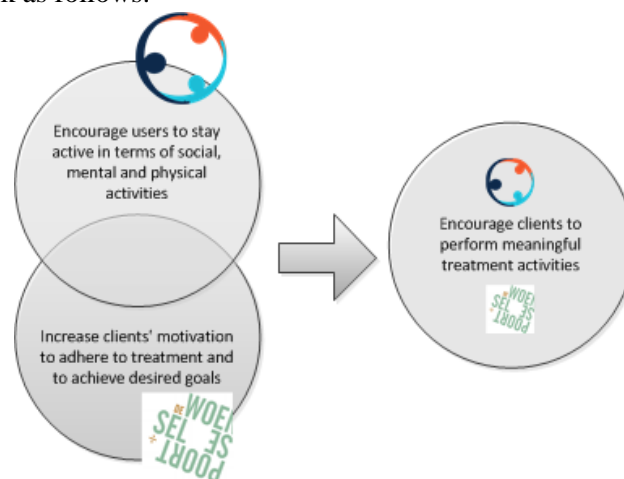


Figure 4. Goal alignment GameBus and DWP.

From Figure 4 it can be seen that the overlapping goal of GameBus and DWP is that they are both striving for healthier people by encouraging them to perform important activities. When GameBus is designed in such a way that the activities are treatment focused and DWP is deciding to use gamification to achieve an increase in the clients’ motivation to improve their HKT-app they would have the same goal in mind. This led to the research objectives that are formulated in 1.5.

### **1.5. Research objectives**

To overcome the problems that DWP is facing, this master thesis proposes the usage of GameBus to motivate the clients to comply to their treatment activities based on the HKT-scores. In addition to that, it will investigate how the employees and clients of DWP can be supported in putting the HKT-app into practice. In other words, the research objective of this master thesis is twofold. Firstly, the first objective is to ‘design a GameBus challenge that will motivate the clients in DWP to comply to their treatment’. Secondly, the subsequent objective is to ‘develop a tool that can support employees of DWP to design a GameBus challenge for a client that will improve the execution of the HKT-app in their daily schedules’. To answer these research objectives several questions should be answered. These questions are structured with the use of the Regulative Cycle of Van Strien (1997). The cycle covers the following steps: problem identification, diagnosis, design, implementation and evaluation. The research questions are discussed in chapter 3.

### **1.6. Scientific and practical relevance**

This research contributes to both scientific and practical knowledge in several ways. These contributions are shortly described below.

*Scientific relevance.* Academic studies about gamification are still relatively young and the field only has a few theoretical frameworks that are well-established (Hamari et al., 2014). Little is known about gamification for mental health and research shows that there is need for user-centered approaches and rapid testing and implementation (Fleming et al., 2016). This study will extend the knowledge on personalized gamification that motivates and monitors forensic psychiatric clients by closely involving the users in the design process.

*Practical relevance for DWP.* DWP will benefit from this research because it will increase the usage of the HKT-app by both clients and employees. It will not only increase the usage, but it will also improve the usability of the app during the entire treatment such that it will not only be a measuring tool. In addition to that, it will provide DWP a tool that can be used to increase the overall motivation and treatment quality of the clients in DWP which will lead to a higher overall health. Besides an increase in overall health, it should also accelerate the treatment process of a client which in turn could fasten the clients flow inside DWP. Patient referral to subsequent care institutions can be accelerated such that DWP can treat more clients in the same amount of time. This would contribute to lessen the challenges the Dutch mental healthcare is facing.

*Practical relevance for GameBus.* Currently, GameBus has not investigated yet the deployment of the app by using treatment related activities. This research will contribute to the investigation of the applicability of GameBus in the (forensic) mental healthcare setting. When this research is successful, GameBus has the possibility to extend it to more clients, to other health departments in the GGzE or to other mental health institutions. In addition to that, the app itself will be tested which will deliver valuable feedback that can be used to improve the application itself. GameBus already has the intention to provide additional functionalities in the future, such as dynamic creation of custom challenges, work with dynamically defined roles and improve the current scoring system. When these improvements are appreciated during this study, it provides more support for GameBus to work on these future improvements.

### **1.7. Structure master thesis**

This master thesis is structured as follows. Firstly, the current knowledge in gamification for health and motivation will be described as an introduction to the research field. This will be followed by the second part of this master thesis that discusses the underlying methodology that was used in performing this research. Afterwards, the thesis starts with achieving the first research objective which is focusing on ‘design a GameBus challenge that will motivate the clients in DWP to comply to their treatment’. This is done by firstly giving a detailed diagnosis that is validating the perceived current situation in DWP. In addition to that, an investigation will be done regarding which design decisions in GameBus needed to be tested during this master thesis project. Subsequently, the feasibility of these design decisions will be assessed by explaining the design and implementation of the GameBus challenges that are investigating GameBus as a motivating and monitoring app in the field of treatment compliance. Consequently, the thesis will continue with investigating the second research objective that reads as follows: ‘develop a tool that can support employees of DWP to design a GameBus challenge for a client that will improve the execution of the HKT-app in their daily schedules’. This will be done by describing the evaluation of GameBus by both clients and employees. It will continue with the development of the decision support tool for DWP that is accomplished with the use of the retrieved information from the implementation and evaluation phase. The master thesis will close with an overall conclusion accompanied with future research recommendations.

## 2. Current knowledge in gamification for health

Before continuing with the master thesis, it is important to get a general understanding of the research field. In this chapter, some additional information about eHealth and gamification is given. The chapter will continue with describing gamification for (mental) health in more detail. Lastly, the current knowledge in the research field of motivation is given.

### 2.1. eHealth and gamification

As stated before, eHealth is an emerging field that combines medical informatics, public health and business. It refers to health services and information delivered or enhanced through the use of technologies. It is not only a technical development, but also a new way of thinking to improve health locally, regionally and worldwide by using information and communication technology. EHealth should be easy-to-use, entertaining and exciting. When all these characteristics are met, eHealth will succeed in achieving the goal that it is aiming for (Eysenbach, 2001).

The advantages of using eHealth in comparison to regular care are: enlarging own control (empowerment), threshold reduction to ask for help, independency of time and place, better fit to individual user experience, greater openness of the client and a smaller chance of forgetting relevant information. However, eHealth can of course not completely replace the regular care since it would depend too much on the technical knowledge and skills of the client, it would lead to a loss in nonverbal communication and there would be a too high dependency on access to and reliability of technology. Therefore, eHealth is a regular care enhancer and not a regular care replacer (Delespaul et al., 2016).

As stated before, a possible application of eHealth is the usage of gamification to improve health. Gamification can be focusing on 4 different categories, namely: internal, external, behavioral change of enterprise programs and behavioral change of individuals. Gamification that seeks to improve health is merely focusing on the latter, which seeks to form beneficial new habits among individuals (Werbach & Hunter, 2012).

When one wants to make the most compelling gamification implementation, it is important to understand the gamification design steps. The Game Element Hierarchy of Werbach & Hunter (2012) provides a guideline for putting all gamification design elements together. They have designed this guideline with the use of three game elements, namely: game dynamics, game mechanics and game components. Putting these three elements together is an important central task of gamification design. When the game designer has knowledge of these three elements, the gamification project will be more compelling. The Game Element Hierarchy is shown in Figure 5.

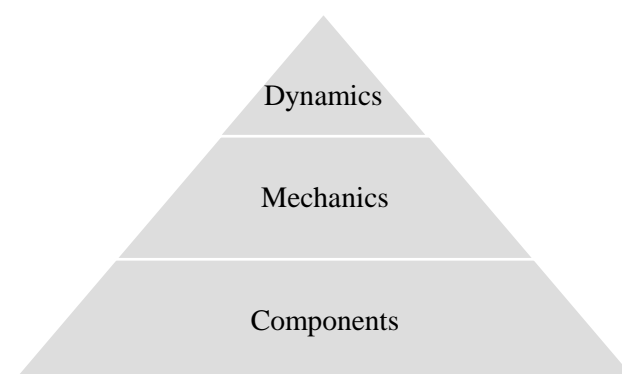


Figure 5. The Game Element Hierarchy (Werbach & Hunter, 2012).

Game dynamics are the highest-level game elements and are the big-picture aspects of the gamified system, but do not directly enter the game. The most important game dynamics are: constraints, emotions, narrative, progression and relationships. Secondly, the 10 most important game mechanics

are: challenges, chance, competition, cooperation, feedback, resource acquisition, rewards, transactions, turns and win states. Finally, the most important game components are achievements, avatars, badges, boos fights, collections, combat, content unlocking, gifting, leaderboards, levels, points, quests, social graphs, teams and virtual goods (Werbach & Hunter, 2012). A short description of each of these elements is given in Appendix B.

## **2.2. Gamification for (mental) health**

As mentioned above, gamification gives the possibility to personalize healthcare. It gives the user a sense of control which will enhance motivation and engagement among the users. The research of McCallum (2012) discussed a taxonomy for categorizing games for health projects. The first possible way to categorize games used in healthcare is by the area of health activity. These areas are: preventive, therapeutic, assessment, educational and informatics. In addition to that, the taxonomy can be extended by identifying the target audience. The target audience can be either narrow or broad. The broader the audience, the harder it is to design the experience and measure the effect of the intervention. When the target audience is narrow, the desired health outcome will be specific, while when the target audience is broad, the health outcome will be more general.

In preparation for this master thesis, a systematic literature review was conducted to research the areas of health activity of McCallum (2012) and game elements of Werbach & Hunter (2012). A total of 30 articles were selected that were focusing on gamification for health improvement. This amount is chosen to have a sufficient number of articles available for this literature study, while still being able to deselect a few articles based on the relevance of their content. The method that was used for finding these articles, an overview of the articles, the research method and the results of the analysis are added in Appendix C. The systematic literature review firstly investigated which goal was mostly pursued in gamification for health. From this literature review it was concluded that most gamification systems for health are focusing on the therapeutic health area which is followed by the preventive health area. McCallum (2012) defines the therapeutic goal as personal rehabilitation and disease management. The main goal of this is to help persons learn how to take care of their body that is now working differently, maintain a high level of health such that secondary complications will be avoided and reintegrate oneself into the society (USA, 2015). In addition to that, rehabilitation of high quality will reduce health costs and hospitalization duration (Turner-Stokes et al., 2006). Afterwards, the game elements were researched by reviewing the most commonly used game dynamics, mechanics and components in the articles. This was done to get an understanding of which types are mostly used in health gamification. The most commonly used game dynamics that were found in the articles are narrative and emotions. Secondly, the top 5 game mechanics were: 1) challenges/feedback, 2) rewards, 3) chance, 4) cooperation and turns and 5) competition. It was also found that self-focused game mechanics are more important in gamified applications for clients than social focused game mechanics. This gives the opportunity to place the individual in the center of action such that it matches the skills and abilities of the individual player. Lastly, the most frequently mentioned game components were: 1) levels, 2) points, 3) avatars, 4) achievements and 5) content unlocking. Again, these were more self-focused than social focused.

A few studies have been researching the feasibility of gamification in mental health specifically. Gamification can have the potential to increase the impact of mental health interventions for three reasons. Firstly, it is more appealing, which can increase the reach of users that might otherwise not use the internet based interventions. Secondly, it has engaging potential because of the game dynamics that will be used. Lastly, it has the potential to be more effective than the traditional health interventions because it utilizes different mechanisms for behavioral change and learning. However, because there are still few independent trials it is not clear how a developer should design the gamified system such that it will achieve significant mental health benefits (Fleming et al., 2016). In addition, gamification

can have the potential to transform mental health services by reinforcing, augmenting and customizing existing therapy activities. It can be used independently by users on demand and player behavior can be quantified and monitored if this is desired (Reynolds et al., 2017). This research will contribute to the current, yet very limited, knowledge regarding using therapeutic focused gamification in mental health. It will involve the end users in the design process such that it is assured that their expectations will be met.

### **2.3. Motivation theory**

Since this master thesis is proposing the usage of GameBus as a motivator for clients to adhere to their treatment, it is important to know what important facilitators are of motivation. Having knowledge of predictors of motivation is important since it will enhance the implementation of GameBus inside DWP. In the next sections, the underlying theory will be discussed that was used for making informed decisions with regard to the best design practices. Since this thesis was focusing on increasing the motivation of clients inside DWP to comply to treatment, a motivational theory needed to be used in investigating the effects of different design decisions on the client's motivation. One of the most influential approaches for motivation is the Self-Determination Theory (SDT) (Ryan & Deci, 2000). This theory will be described below followed by describing treatment awareness, fairness and fun as other important predictors for increasing motivation.

#### **2.3.1. Self-Determination Theory**

The SDT focuses on the social-contextual conditions that either facilitate or forestall the process of self-motivation and healthy psychological development. More specifically, different factors have been researched that either enhance or undermine intrinsic motivation, identified self-regulation and well-being. Intrinsic motivation is driven by interest or enjoyment in the task itself. It exists within the person rather than depending on external pressures or a desire for compensation. Identified self-regulation concerns the most autonomous kind of extrinsic motivation. It occurs when the behavior is valued and perceived as being a personal choice. This occurs when the person values the activity as personally important. It is still extrinsic because the activity is performed as a means to an end and not for the activity itself (Guay et al., 2000). It is postulated that there are three innate psychological needs which, when fulfilled, will lead to enhanced self-motivation and mental health. These three basic psychological needs are competence, autonomy and relatedness (Ryan & Deci, 2000). First of all, competence is about the need for challenge, feelings of control over the outcome and experience of mastery. Secondly, autonomy concerns the sense of volition or choice in one's decisions and actions. Lastly, relatedness is experienced when a person feels connected to others (Ryan et al., 2006).

It is important that GameBus takes these three needs into consideration, because when these needs are not supported it can lead to a reduction in self-motivation and well-being (Ryan & Deci, 2000). Therefore, the designs in GameBus should be designed appropriately such that the dimensions of SDT would be supported by the usage of GameBus. So, when GameBus is designed appropriately, the three dimensions of the SDT should be increased. Consequently, the intrinsic motivation and identified self-regulation of the clients should increase by using GameBus. This is in line with the SDT and with the general idea of implementing gamification for therapeutic reasons.

#### **2.3.2. Treatment Awareness**

In addition to the SDT, another variable needs to be considered in increasing motivation to comply to treatment. This variable was 'treatment awareness'. This variable can be defined as the degree to which the clients in DWP have the feeling that they are working actively on their rehabilitation to get back in the society. It is about whether they are aware of the fact that the activities that they perform are all in some way improving their risk taxation and their health. Research has shown that there is a

correlation between the awareness of a (mental) health condition and the compliance to therapeutic regimen (Heydari et al., 2015). Increasing the awareness of clients thus should benefit to their compliance motivation and in turn their health outcomes.

### **2.3.3. Fairness and fun**

Two very important aspects need to be discussed before continuing with this master thesis. Although GameBus has the possibility to motivate clients to comply to their treatment because of the SDT and treatment awareness, these relations would be mitigated when the users perceive the GameBus challenges as unfair and not fun (Alcorn & Turner, 2015). The combination of fairness and fun ('an enjoyable game experience') can thus be seen as a moderator variable that can harm the positive effect of GameBus usage on motivation to comply to treatment.

Fairness is in this matter not that much equality of outcome, but equality of opportunity (Gilbert, 2013). Each player should have an (almost) equal chance of winning the challenges. Fairness will be taken as much as possible into account from the start by delivering the users a range of activities that can be performed and by being transparent and consistent in delivering information to all users regarding the challenges. In addition to that, the users should also have a feeling of distributive justice. This means that the users should have the feeling that the amount of points they received matches with their delivered inputs and matches in comparison to the points from others (Colquitt & Rodell, 2015). They need to have a feeling of being treated fairly, since this is one of the primary rewards for the brain. Research showed that it can be even more rewarding for the brain than monetary rewards (Rock, 2009). Since whether something is perceived fair by the users is rather a subjective feeling it is important to evaluate and act upon the level of perceived fairness of the users of each challenge.

Secondly, whether a user perceives games, and more specifically for this research GameBus, as fun depends on several factors. Fun is the key to create motivation and make a success of gamification. However, fun is a tricky word to use in gamification design. Different researches have been performed on what fun should be in gamification. Fun is the reason people want to continue playing a game, it is the core value that is needed in user engagement and in increasing intrinsic motivation. Inserting fun in gamification means that the user should have a sense of mastery, choice, fair competition and identity (Ventrice, 2011). As can be seen from this definition, fun is closely related to the feelings of competence, autonomy and relatedness from the SDT. Fun is thus more than just putting some game mechanics into work and let users play the game. In addition to that, giving the users a sense of control and autonomy over the outcomes would give them a stronger positive emotional response than when they are lacking this sense of control and autonomy (Rock, 2009). This positive emotion can also contribute to the perceived enjoyability of a game, because it will manage their level of mastery and choice. As can be concluded, fairness, fun and the SDT are three constructs that closely interact. They should be examined together during the implementation and evaluation of the GameBus challenges.

## **2.4. Conclusion & discussion**

So in conclusion, this chapter has described the current knowledge with regard to gamification for (mental) health and the important characteristics of user motivation. It started with describing motivation in general and continued with describing important facilitators of motivation in gamification. These constructs should especially be taken into consideration during the achievement of the first objective of this study which is about designing GameBus in such a way that it will increase the motivation of clients in DWP to comply to their treatment. These constructs are valuable criteria that can be used for assessing the best design decisions in GameBus. Therefore, hypotheses will be created on the basis of this knowledge that in turn will be used for the evaluation of GameBus. These hypotheses will be described in the methodology chapter accompanied with its sub-research questions.

## **PART 2**

### **RESEARCH METHOD**

This part describes the underlying methodology that was used in this master thesis. It will describe the main research questions and its sub-research questions together with the steps that were taken to be able to answer each of these research questions. In addition to that, a description of the pilot study that was used in this research is given. Finally, the preparations for the quantitative evaluations are described.



### 3. Methodology

This section provides the methodology that was used in this research. Firstly, the problem statement will be briefly repeated in section 3.1. Afterwards, the main research questions will be given accompanied with its sub-research questions. In section 3.3, the research framework will be given that guided the sequential steps that needed to be taken in this research. Afterwards, the pilot setup and the pre-, intermediate- and post-test descriptions in section 3.4. Finally, the preparations that are needed to be performed before it was possible to perform quantitative evaluations are conducted.

#### 3.1. Problem statement

As mentioned in the introduction, there is a growing interest in using gamification in supporting personalized health. DWP developed the HKT-app because they see the added value of using eHealth applications in supporting the treatment of their clients, but until now they have not succeeded yet in implementing this app in the entire organization. The HKT-app can be of great value in personalizing health and by giving the clients a feeling of empowerment, if there is sufficient support. GameBus can provide this support to the clients by delivering an application that will motivate and monitor them throughout their entire treatment based on their HKT-scores. To be able to achieve this goal, a research should be conducted on how to design GameBus in such a way that it will enhance and accelerate the treatment of the clients in DWP. Afterwards, a decision support tool should be developed that can help employees inside DWP to develop GameBus challenges on the basis of the HKT-scores of a specific client. This will increase the usability and importance of the HKT-app and will decrease the difficulties the employees and clients are facing with putting the HKT-app into practice.

#### 3.2. Research questions

This section describes the main research questions that were derived from the problem statement. The overall goal was to search for the right design decisions in GameBus that fit the personal wishes of clients in DWP in such a way that it will motivate them throughout their entire treatment to comply to the agreements made. There is already a solid theoretical basis regarding increasing motivation. However, inside GameBus different decisions still needed to be made regarding the best design practices for increasing motivation to comply to treatment inside DWP. When this is known, a decision support tool can be developed that can guide employees inside DWP through the development of a GameBus challenges on the basis of the HKT-scores of a specific client. This could improve the implementation of the HKT-app by providing support on a practical daily level to both employees and clients. In order to be able to achieve this goal, two main questions were formulated.

#### Main Research Questions

*Which design of GameBus achieves the highest motivation to comply to treatment of clients in DWP?*

*How can the findings from the implementation of GameBus be used for the development of a decision support tool for personalized GameBus challenges?*

These main research questions will be split up in smaller sub-questions that will guide this master's thesis project. These questions will serve as a guideline throughout the whole project. For formulating these sub-research questions, a framework was chosen that increased the academic validity of the research. An important note to make is that this framework was used in a controlled setting and not for an organization wide redesign plan. The framework that was used is based on the Regulatory

Cycle of van Strien (1997). A small adaptation was applied by adding two extra arrows that made it possible to go from either the implementation or evaluation stage to the design stage again. Since the master thesis was focusing on designing GameBus in such a way that it fits the needs of the clients of DWP it needed to be possible to go from testing one design to an improved design based on that feedback. The extra arrow that was added between the evaluation and design phase made it possible to have a few iterations in these two stages before continuing to the final evaluation. In addition to that, the other extra arrow made it possible to propose the set-up of the decision support tool based on the final evaluation. The adapted regulative cycle is shown in Figure 6.

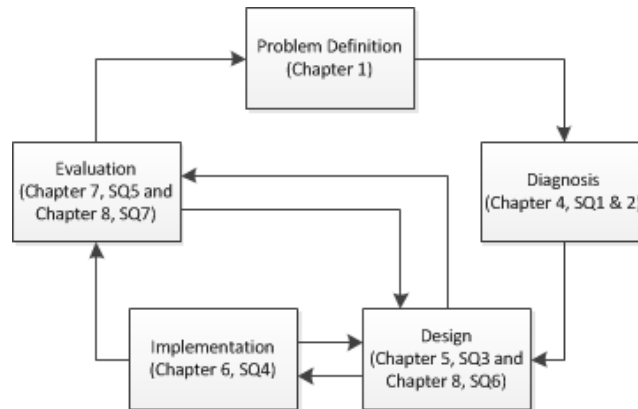


Figure 6. The adapted regulative cycle.

For each stage, the used sub-research questions are given in the upcoming sections.

### 3.2.1. Diagnosis

In this phase, an investigation was done regarding the problem that was defined in the introduction. This problem was defined based on perceived problems that were derived from conversations with both employees and clients inside DWP. However, this problem still needed to be validated in more detail. More specifically, the current obstacles for both the client and the employee that lead to a low usage of eHealth and a low motivation to comply to treatment were investigated. In addition to that, an investigation needed to be done regarding which design decisions needed to be implemented and evaluated during this master thesis. This was done by evaluating the current developments in gamification design and by reviewing the possible design decisions that could be adapted in GameBus. This led to the following research sub-questions:

*SQ1: What are the current obstacles inside DWP that lead to a low usage of the HKT-app and a low motivation to comply to treatment?*

*SQ2: What information can be retrieved from available literature and GameBus regarding successful gamification design for increasing motivation and providing an enjoyable game experience?*

*SQ2.1: What information from the literature can be retrieved regarding new developments in gamification design for increasing motivation and providing an enjoyable game experience?*

*SQ2.2: Which parameters in the design space of GameBus can be adjusted for making successful gamification design for increasing motivation and providing an enjoyable game experience?*

### 3.2.2. Design

In this step, the different designs of GameBus were created. This was done with the obtained information from the diagnosis phase. A decision was made regarding which activities needed to be implemented in the GameBus challenges and which different design decisions could be made, both based on available literature and available data, during the pilot. A last step in this master thesis project was to develop a decision support tool for personalized GameBus challenge development. This question was answered as a final step in this master thesis but fell within the design step. These steps could be summarized in the following sub-questions:

*SQ3: How can the information from the diagnosis phase be used to develop a successful GameBus challenge?*

*SQ3.1: Which different design decisions can be applied in developing GameBus challenges?*

*SQ3.2: Which data is available and can this data be used to optimize the GameBus challenges in terms of activities or scoring systems?*

*SQ6: How can the information from the implementation and evaluation phase be used to develop a decision support tool that helps an employee with personalized GameBus challenge development?*

*SQ6.1: Which input and output data should be used in this decision support tool?*

*SQ6.2: Which decision models should be implemented in this decision support tool?*

### 3.2.3. Implementation

After each design step, the designs were implemented and tested with the usage of a small pilot. A review was done regarding which improvements should be made to the GameBus challenge to make it more appealing to the clients with the use of a short interview and questionnaire. These answers formed the basis of the next design phase. Besides the test of the design itself, the activities and scoring systems that were added in the challenges will be evaluated. These results formed the basis of the new upcoming cycle in which the improved design was tested. This led to the following research sub-questions:

*SQ4: Which GameBus design achieves the highest motivation to comply to treatment of clients in DWP and satisfies the dimensions of fairness and fun?*

*SQ4.1: What are the user experiences of the first GameBus challenge in terms of motivational effects, fairness and fun?*

*SQ4.2: What are the user experiences of the second GameBus challenge in terms of motivational effects, fairness and fun?*

To be able to answer these research questions literature regarding motivation was reviewed to construct a model that could serve as a theoretical basis during the evaluation of each implemented design. This model was based on the motivational theory that was discussed in 2.3. This theory made it possible to formulate a number of hypotheses that formed the basis for the implementation and

evaluation phase of the GameBus design. These hypotheses were used to make informed decisions based on available scientific literature. The hypotheses read as follows:

Since GameBus has the possibility to make teams with the people around you and challenge each other to score as much points as possible it is assumed that GameBus usage will increase the feeling of being connected to other users. Therefore, the following hypothesis is formulated: ***Hypothesis 1: GameBus usage has a positive effect on the relatedness of the users.***

Within GameBus, the users have the possibility to choose between different activities. Because of this, the users can decide and choose to perform the activities that are important for them personally, which will enhance their feelings of autonomy. This leads to the following hypothesis: ***Hypothesis 2: GameBus usage has a positive effect on the autonomy of the users.***

When the clients in DWP will use GameBus they will feel challenged to perform the activities that are important during their treatment. Because GameBus gives points for each activity they perform which will lead to a high score on the leaderboard this can give the users a sense of mastery experience, thus: ***Hypothesis 3: GameBus usage has a positive effect on the competence of the users.***

Since GameBus will stimulate the clients in DWP to work on their HKT-scores by performing activities that are important for them, it is assumed that it will increase the degree to which the clients have the feeling that they are actively working on their treatment. Therefore, hypothesis 4 can be formulated as follows: ***Hypothesis 4: GameBus usage has a positive effect on the treatment awareness of the users.***

As stated in section 2.1, it is already known that gamification has the potential to increase motivation by using certain game dynamics, mechanics and components (Werbach & Hunter, 2012). Since GameBus is using game elements such as challenges, rewards, competition, points and leaderboards it will positively stimulate motivation. The research specifically focused on the intrinsic motivation and identified self-regulation of the clients. The reason for this is that intrinsic motivation and identified self-regulation are the key to both short-term and long-term treatment compliance (Richard et al., 1997; Teixeira et al., 2012). This leads to the following hypothesis: ***Hypothesis 5: GameBus usage has a positive effect on the intrinsic motivation to comply to treatment of the users.*** And: ***Hypothesis 6: GameBus usage has a positive effect on the identified self-regulation to comply to treatment of the users.***

In addition to the above proposed hypotheses. The importance of fun and fairness in gamification should not be forgotten. As can be concluded from section 2.3.3 both fairness and fun are very person related. A person should have the feeling that they are in control of the game to increase the level of perceived fairness and fun. Therefore, it is expected that the more adapted to the personal needs the challenge is with the use of the intermediate results, the more a player experiences a game as fair and fun. Therefore, the following hypotheses were formulated: ***Hypothesis 7: Adapting GameBus to the personal needs has a positive effect on the perceived fairness of the challenges.*** And: ***Hypothesis 8: Adapting GameBus to the personal needs has a positive effect on the perceived fun of the challenges.***

All above concepts were considered during the pre-test, intermediate-tests and post-test questionnaires and interviews. The variables were both measured quantitatively by asking the participants to measure themselves on specific questions. In addition to that, the interviews were analyzed by using

labels and codes that described the above variables. An overview of the coding scheme can be found in Appendix P. In this way, it could be investigated whether the participants had a feeling of relatedness, autonomy, competence, treatment awareness, fairness and fun during the pilot. In addition to that, the interviews were used to improve the upcoming design based on the experiences of the participants.

### 3.2.4. Evaluation

At the end of the last design an overall evaluation was done regarding which improvements could be made in the future to GameBus and the applicability of the GameBus challenge in DWP. In addition to that, an evaluation was done with both clients and domain experts regarding smart scoring systems. These findings resulted in a decision support tool for the employees inside DWP that can guide them through the development of a GameBus challenge for a certain client which is part of the design phase. This decision support tool was evaluated with a few employees with the use of a small checklist. This led to the following research questions:

*SQ5: How should GameBus be designed such that it is applicable in practice by DWP?*

*SQ5.1: What improvement points should be added to the GameBus challenge?*

*SQ5.2: What are the clients' and employees' opinions about the different types of smart scoring systems?*

*SQ7: What are the employees' opinions about the decision support tool?*

### 3.3. Research process

As was stated in section 3.2, a framework was used to guide this research accompanied with different research questions in each step. These research questions can be translated to a specific research process that is shown in Figure 7.

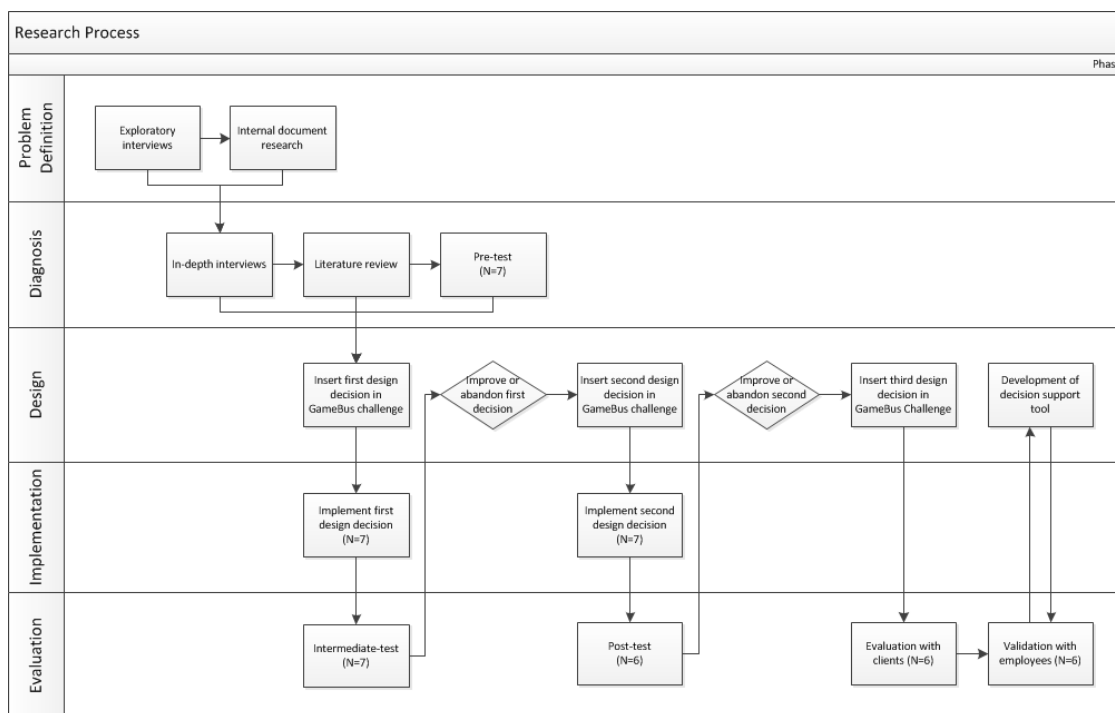


Figure 7. Overview master thesis process.

For the implementation and evaluation process steps, a small pilot study was used to validate each different design decision. It was important that the steps that were taken in DWP regarding eHealth were kept small. The main reason for this is that domain experts have indicated that the resistance is large and when the changes are too big these changes will not be adopted. From the perspective of elements of organizational change, one could argue that currently there is a normative perspective regarding organization change. This means that the members of the DWP feel they ought to change, but they do not want to change yet (which is the cognitive perspective). This implied that the change capacity of DWP was rather low and the chance of successful organization change was small (Palthe, 2014). Therefore, the decision was made to focus on the clients in DWP first during this pilot. When this pilot is successful, the change capacity can increase and the employees of DWP will be involved in the research. In this way, the chances of dissatisfaction and failure will be decreased.

### 3.4. Pilot

For this study, a research method was chosen to be able to structure the research. A research method is important because it gives direction and it systematizes the study. Since the aim of this study was to get insights in which design decisions in GameBus works best within DWP and it was performed on a relatively small scale a pilot study suited best. A pilot study is used to ‘examine the feasibility of an approach that is intended to be used in a larger scale study’ (Leon et al., 2011). A pilot study can thus be used as an initial step in exploring the user perceptions of an application, which is the goal of this master thesis.

The goal of the pilot was to investigate which design of the GameBus challenges provided the highest user motivation and highest perception of fairness and fun. The pilot had a total time span of 8 weeks in which one week was used for the improvement of the challenges based on the intermediate feedback. During the pilot, the clients participated in different GameBus challenges and they were asked to fill in a short pre-test questionnaire, meet for intermediate tests and fill in a short post-test questionnaire accompanied with a closing interview.

#### 3.4.1. Participants

This study used a total of 7 participants in the pilot. Important characteristics of test users are that they reflect the target audience in terms of gender, educational level, age and any other demographic characteristic that is unique to the objective of the designed application (Moreno-Ger et al., 2012). Since this study was a short-term pilot study in which the practical potential of GameBus as a motivator was tested, it was assumed that this amount of test users would also be sufficient to get insightful results regarding the best design practices of the app. The participants were reached by passing by different departments and personally asking them whether they wanted to participate in my research. The participants were from both Woensel and Poort from which their demographic information is given in Table 1.

*Table 1. Demographics of the participants.*

|                          |            | Respondents |      |
|--------------------------|------------|-------------|------|
|                          |            | N           | %    |
| <b>Gender</b>            | Male       | 6           | 86 % |
|                          | Female     | 1           | 14 % |
| <b>Age</b>               | ≤ 25       | 1           | 14 % |
|                          | > 25, < 40 | 5           | 72 % |
|                          | ≥ 40       | 1           | 14 % |
| <b>Technology skills</b> | Low        | 1           | 14 % |

|                                    |                      |   |      |
|------------------------------------|----------------------|---|------|
|                                    | Medium               | 5 | 72 % |
|                                    | High                 | 1 | 14 % |
| <b>Duration of hospitalization</b> | ≤ 1 year             | 3 | 43 % |
|                                    | > 1 year, ≤ 2 years  | 3 | 43 % |
|                                    | > 2 years, ≤ 3 years | 1 | 14 % |
|                                    |                      |   |      |
| <b>Department</b>                  | Woensel              | 2 | 28 % |
|                                    | Poort                | 5 | 72 % |

The percentages of respondents per demographic given that are shown in Table 1 were evaluated with domain experts. This was done in order to be able to conclude whether the pilot participants are a decent representation of the complete client population in DWP. They indicated that these percentages largely match with the actual ratios for each demographic given in DWP. Therefore, we can assume that they reflect the target audience in a decent manner.

### 3.4.2. Pilot procedure

This section describes the procedure that was used during the pilot. In other words, it is describing the time planning of the pilot, when and how the interviews were conducted and when the adaptations to the GameBus challenges and the final evaluations took place.

The following flow chart in Figure 8 represents the time frame in which the pilot and evaluations took place.

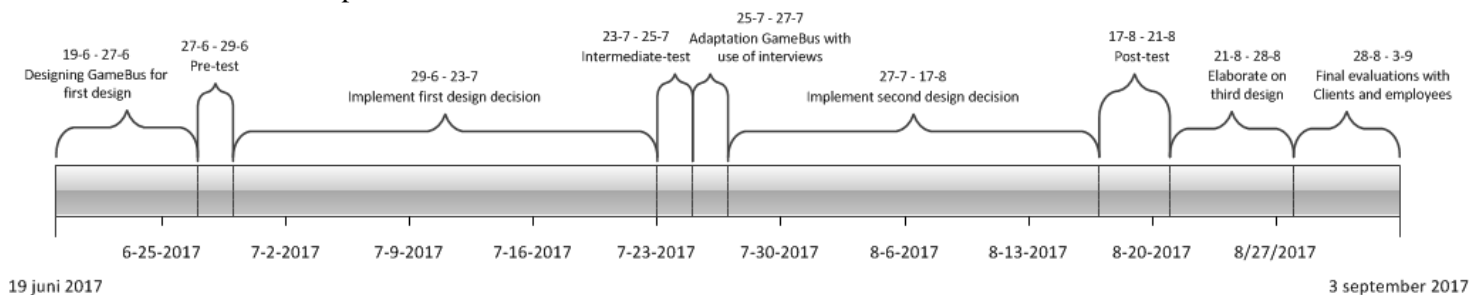


Figure 8. Timeline pilot study.

As can be seen in Figure 8, the first step was to make the first challenge design in GameBus. Thereafter, a pre-test was conducted which was followed by the implementation of the first design decision. During the implementation phase, weekly meetings were planned with the clients to discuss their weekly activities and ask whether everything was clear for them. When this test phase was finished, the intermediate-tests were performed on the days after the test phase. These tests were planned in a 30-minute time frame with each pilot participant on either Thursday or Friday. Each interview took about fifteen minutes. The interviews were conducted at DWP and were recorded such that they could be written out on a later moment. The feedback from these interviews was used to adapt GameBus in the upcoming design. After this adaptation, the second design decision was implemented in GameBus. The post-test was performed in the same way as the intermediate-tests. These interviews were planned in a 30-minute time frame as well. Each interview took about 20 minutes. The results from the first two design decisions can be found in chapter 6. Based on this post-test, the decision was made to create a last design that was only developed on paper. This last design was evaluated with the pilot participants with the use of a short personal conversation. Finally, a total of 6 employees were asked to evaluate the GameBus challenges. These evaluations can be found in chapter 7. Finally, all results were combined for the development of the decision support tool that is described in chapter 8.

### 3.4.3. Implementation strategy

The participants from Woensel had quite some limitations inside DWP. These limitations needed to be taken into account during the implementation phase of the pilot. The most important limitation was that they did not have the possibility to have a smartphone and they do not have internet access in their rooms. This meant that they could not access the internet on a daily basis. This limitation was largely solved by using a combination of automatic and manual registration of the activities which is described in more detail in 5.1.3.

Another limitation was that some of the clients encountered difficulties with understanding and using the app. This was remedied by starting the pilot period with a group meeting in which everything was explained to each individual client on a detailed level. This gave them the opportunity to ask questions and instructions for the upcoming weeks. In addition to that, the weekly meetings were also used to solve the difficulties that a client might have encountered during the previous week. This reduced the possibility of negative emotions which could have harmed their experiences. It was difficult to share the workload of these meetings with other people inside DWP since their knowledge of the research and GameBus was too little to be able to help the clients in a decent manner.

### 3.4.4. Test strategy

Different questionnaires and interviews were used to test the GameBus challenge designs. As stated before, there was a short pre-test questionnaire, intermediate questionnaires and interviews and a short post-test questionnaire accompanied with a closing interview.

#### 3.4.4.1. Pre-test

Before the pilot was started, it was important to get an insight in the scores of the pilot participants on a few measures.

First, it was important to get an insight on their current level of autonomy, competence and relatedness. Or in other words, on the self-determination theory. This was done with the use of an 11-item questionnaire of Vlachopoulos et al. (2010). This questionnaire was translated to Dutch and was measuring the level of *autonomy* with 4 items (number 2, 5, 8 and 11). An example of one of these items is the statement: "I feel that I have the opportunity to make choices with regard to the way I perform my treatment activities".

Secondly, the level of *competence* was measured with 4 items as well (number 1, 3, 6 and 9). An example is: "I feel I perform successfully the activities of my treatment program".

Thirdly, the level of *relatedness* was measured with 3 items (number 4, 7 and 10). One of which was as follows: "I feel I have excellent communication with the people inside DWP".

Additionally, the questions to measure *intrinsic motivation* and *identified self-regulation* were retrieved from the Situational Motivation Scale (SIMS) (Guay et al., 2000). Both variables were measured with 4 items. All items were answering the question: "Why are you engaged in your treatment activities?". An example of an intrinsic motivation item was: "Because I feel good when doing this activity". An item of identified self-regulation scale was: "By personal decision".

Since the Dutch questionnaire was not available, the questionnaires needed to be translated in person. Aspects that ensure equivalence were taken into account as much as possible such that the reliability and validity of the questions was guaranteed. This was done with the back-translation technique to ensure linguistic validity and by an evaluation of the questions by domain experts inside DWP to increase cultural validity (Boyle, 1996). Each of the above-mentioned scales were calculated by taking the weighted means of the items of that particular scale. None of the items needed to be reversed before calculating the means since none of the items were worded in the negative direction.



Secondly, their HKT-scores were measured to get an understanding of their current clinical risk factors. These questions were retrieved from the ‘HKT-app’ which is measuring each risk factor on a scale from 1 to 5. The complete pre-test questionnaire can be found in Appendix D.

#### **3.4.4.2. Intermediate-tests**

At each decision moment, a short interview was held to gain insights into the experiences with GameBus. Different types of interviews can be used to obtain qualitative data, depending on the research purpose. Since this research was focusing on evaluating different design decisions in GameBus, it can be defined as an evaluative study. The most commonly used interview form for evaluative purposes is the semi-structured interview (Saunders et al., 2016). This means that an interview was drawn up with some key questions that needed to be covered. In addition to that, there was sufficient room left for additional information. This was of added value, because it made it possible to respond to the interviewee slightly different from interview to interview (Van Aken et al., 2010). Each interview had the goal to find out how the participants were experiencing the challenges in GameBus. In addition to that, the interviews were used for each decision-making point that is shown in Figure 7. The main themes of the interview questions were the experiences of the pilot participants in terms of motivation, fun and fairness regarding the different designs. In addition to that, the pilot participants were asked which improvements they thought would be valuable to make to the GameBus challenge.

The interviews were combined with a short questionnaire. This questionnaire was used for the assessment of perceived fairness and fun for both designs in a quantitative manner. The reasons why these questionnaires are called quantitative measures is because these scales make it possible to give a value to the perceived fairness and fun. The questionnaire that was used to measure fairness quantitatively was retrieved from the ‘justice and fairness’ measure of Colquitt and Rodell (2015). It was using the 4-item scale that is measuring *distributive justice*. An example of one item is: “The outcomes of the challenge are a good reflection of what I have done in the past weeks”.

*Fun* was measured with the use of the ‘Interest/enjoyment’ measure of the Intrinsic Motivation Inventory questionnaire (SDT, 2017). This measure consists of 7 items of which one example is: “I enjoyed participating in the GameBus challenges very much”. Both scales could be calculated by averaging the items responses for that scale. Before the fun scale was averaged, two items needed to be reversed since they were worded in negative direction.

Since fairness and fun are very subjective measures, one could argue that measuring it is a difficult task. However, the article of Wixon (2011) provides a good method for measuring such a subjective measure. The article states that a researcher should combine both quantitative measures with qualitative measures. So, when a global assessment score is used to measure fairness and fun, it should also include a qualitative assessment of factors that may drive the perceptions. This can provide insightful clues to understand the determinants of fairness and fun which in turn could be taken into consideration during the development of the challenges. Therefore, both quantitative and qualitative evaluations were taken into account during the pilot. The intermediate-tests that were used for this research are attached in Appendix E.

#### **3.4.4.3. Post-test**

The post-test consisted of both a short questionnaire and an interview. The questionnaire was asking roughly the same questions as the pre-test questionnaire and intermediate-test questionnaire. Two adaptations were applied to this questionnaire. First, the questions regarding the HKT-scores were left out of the questionnaire since these values were only used to get a general understanding of the risk taxations of the pilot participants. Secondly, a small change was applied to the questionnaire in order to be able to measure the MCID. The MCID is ‘a concept used to determine whether a medical intervention improves the perceived outcomes in patients’ (Rai et al., 2015). The MCID is a powerful tool to

investigate the smallest change in an intervention outcome that a patient would identify as clinically important and is not relying simply on significant differences. This is because statistically differences in measures do not necessarily mean that the benefits are clinically meaningful (Sterne & Smith, 2001). Combining both statistical differences with the MCID improves the interpretability and robustness of the results. Different methods can be used to establish the MCID, but this study is using the anchor-based method (Kim & Park, 2013). More explanation regarding this method is given in 3.5.2. The interview was used to gain insight in the experiences of the participants regarding the last GameBus challenge and regarding the usability and opinions of GameBus in general. Their experiences were investigated with respect to motivation, fairness and fun. The post-test questionnaire and interview can be found in Appendix F.

### **3.5. Preparations for the quantitative evaluations**

The pre-, intermediate- and post evaluations consisted of different scales that were used to evaluate the important constructs of this study quantitatively. A paired-samples t-test was performed to check for significance between each measure moment, however, not too much value should be attached to achieving significant results because the main goal of this study was to investigate the feasibility and because of the small pilot group. Therefore, the most meaningful results from the t-test were whether the mean scores were higher or lower in comparison to the two decision moments. Before the quantitative evaluation could be performed, some preparations had to be made. These preparations included the assessment of the reliability of the scales and the further explanation of the MCID (Minimal Clinically Importance Difference).

#### **3.5.1. Reliability of scales and test for normality**

An important first step in performing the quantitative evaluation of GameBus is to assess the reliability of the scales that were used in the questionnaires. These reliability assessments were done with the usage of the Cronbach's alpha, which is an index that represents the internal consistency of a scale. It is expressed as a value between 0 and 1 in which values ranging from .70 to .95 represent acceptable values of a particular scale (Tavakol & Dennick, 2011). The values of the Cronbach's alpha for each scale are given in Table 36 in Appendix N.

Additionally, a paired-samples t-test was used to measure statistical differences between two time points per scale. A number of requirements needed to be met to be able to perform a paired-samples t-test, namely: the dependent variable is continuous, the subjects in each sample group should be the same and the differences between the paired values should be normally distributed (Norušis, 2006). The first two requirements were already met, however, the normality of the differences needed to be checked. These tests are given in Table 37 in Appendix N. When the significance level is  $>.05$  this means that the data is normally distributed (Ghasemi & Zahediasl, 2012). It can be concluded that, except for the relatedness measurement, each mean difference was normally distributed. Therefore, the relatedness construct needed to be treated with great caution when running the paired-samples t-test.

#### **3.5.2. Minimal Clinically Importance Difference**

As stated before, the questionnaires aimed at answering a number of questions. Before these evaluations could be done, the MCID values needed to be calculated. As stated before, the MCID is a valuable measure for assessing the clinical importance of a specific intervention. It solves the problem that statistically significant results may not always be clinically relevant, or equally, a clinically important finding may not always be statistically significant. Since this pilot was using a small sample size, significant results would be very fragile and often not generalizable (Faber & Fonseca, 2014). Therefore, significant results needed to be interpreted very carefully. Evaluating the results with the use of the MCID provides a more meaningful evaluation of the user experiences of the GameBus challenges.

The research of Landorf and Radford (2008) provides a method for the calculation of the MCID by using the anchor-based method. This method was used for assessing the MCID for the different constructs of this study. An overview of this method is shown in Figure 9. The anchor method uses a global question (anchor question) that assesses change at each follow-up appointment during the pilot. The participants were asked whether they experienced improvements because of the intervention. They could answer this question ranging from ‘yes, a lot’, ‘yes, a little’, ‘no’ to ‘no, made it worse’. Based on these anchor questions, the MCID could be calculated for each scale by subtracting the mean change of the group that experienced no change from the mean change of the group that experienced a little change.

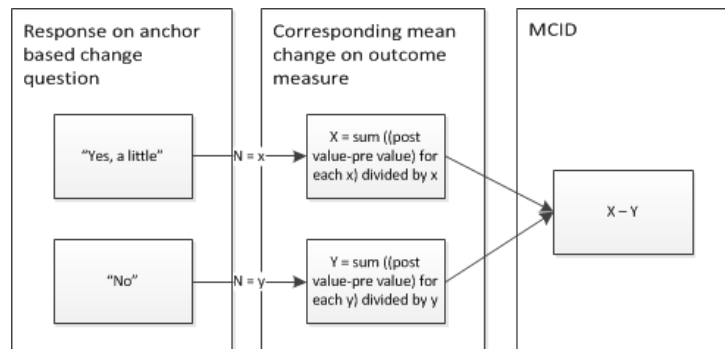


Figure 9. Process for MCID calculation.

An overview of the outcome measures, their corresponding constructs and the number of data entries are given in Table 2. For each of the constructs, the MCID’s were calculated. These MCID’s were then used to assess the user experiences of the different designs. An important point of attention is that at the end of the pilot period, one client left the pilot group due to a transfer to another institution. This participant did participated in the entire pilot and participated in the pre- and intermediate-tests, however, he dropped out just before the post-test.

Table 2. Overview of outcome measures and the corresponding constructs.

| Outcome measure                 | Constructs            | n | Measured during    | Measured for                                    |
|---------------------------------|-----------------------|---|--------------------|---|
| SDT (Self-Determination Theory) | Relatedness           | 6 | Pre- and post-test | Experience GameBus in general                   |
|                                 | Autonomy              | 6 |                    |   |
|                                 | Competence            | 6 |                    |   |
|                                 | Intrinsic motivation  | 6 |                    |   |
|                                 | Identified regulation | 6 |                    |   |
| Fun                             | Interest / enjoyment  | 6 | Intermediate-tests | Experience non-personalized versus personalized |
| Fairness                        | Distributive justice  | 6 | Intermediate-tests | Experience non-personalized versus personalized |

For each of the constructs the MCID values will be calculated by going through the MCID calculation process that is shown in Figure 9. These values indicate what the minimal change needs to be between the two measure moments in order to make it a clinically important difference. This value in turn needs to be compared to the mean change between the two measure moments and the 95% Confidence Intervals (95% CI’s) for that construct that are retrieved from the paired-samples t-tests.

Based on these results, one could judge whether the difference between the two measure moments is definite, probable, possible or definitely not clinical important. These judgements could be made with the use of Figure 10. This figure shows the possible graphs that can be created accompanied with their corresponding conclusion. The X shows the MCID value and the line with the sphere in the middle and the lines at the end show the t-test results. The sphere is the mean change between the two measure moments and the line is the 95% CI of that difference.

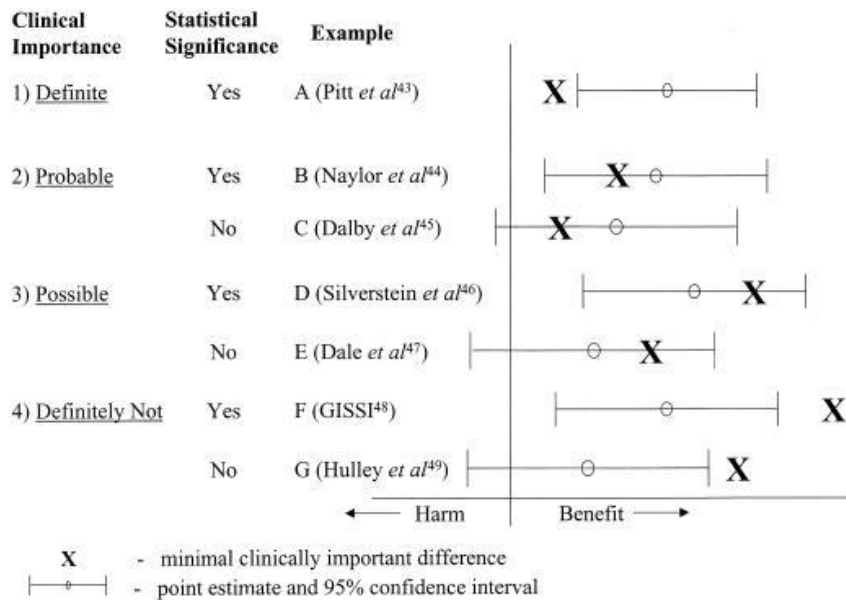


Figure 10. Possible conclusions based on CI's and MCID (Man-Son-Hing *et al.*, 2002).



## **PART 3**

### **FEASIBILITY STUDY OF GAMEBUS**

This part describes the examination of the first research goal. It will start with a validation of the perceived problems that DWP is facing regarding a low motivation to comply to treatment and a low usage of the HKT-app. Afterwards, the different design decisions that were applied in the pilot are described. Finally, the implementation will be described which will conclude with the results that were retrieved from the pilot. This part is thus focusing on testing the feasibility and best design practices of GameBus as a motivating and monitoring app for treatment compliance.

## 4. Diagnosis

The purpose of this phase was to validate the problem that was defined in 1.4, to explore and validate the causes and effects of the problem and lastly, to develop solutions for the problem. The problem that DWP is facing is a low usage of their self-developed HKT-app by both employees and clients and a low motivation to comply to treatment among the clients in general. A well performed diagnosis phase should consist of both an empirical and a theoretical analysis (Van Aken et al., 2010). Firstly, the empirical analysis was performed by answering sub-question 1. Afterwards, an investigation was performed regarding which design decisions should be applied to GameBus during this master thesis project. These findings were delivering an answer to sub-question 2.

### 4.1. Current obstacles

This section is answering the first sub-question that was formulated as follows: *What are the current obstacles inside DWP that lead to a low usage of the HKT-app and a low motivation to comply to treatment?* A well-performed empirical analysis consists of a few steps, namely: 1) validating the business problem and specify its characteristics, 2) exploring the causes of the problem and 3) validating the causes of the problem and identify its relative importance (Van Aken et al., 2010). These steps formed the basis for answering sub-question 1.

#### 4.1.1. Problem validation

The problem that DWP is facing is a low usage of the HKT-app and a low motivation to comply to treatment. These two problems needed to be validated by both employees and clients. This was done with the use of interviews that were held with both groups. After interviewing employees from 10 out of the 16 wards it became clear that the usage of the HKT-app is very low. They replied to the question ‘How often do you use the HKT-app?’ as shown in Figure 11. The figure shows the percentage of employees that responded with a specific frequency to the question.

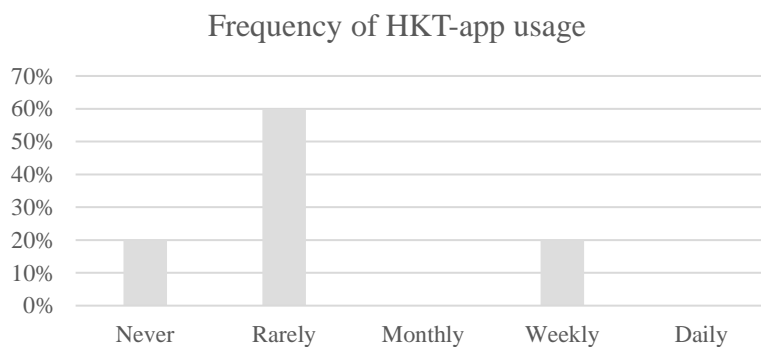


Figure 11. Percentage of responded frequencies of HKT-app usage among interviewed employees.

As can be seen in Figure 11, the usage of the HKT-app among employees is extremely low. Most of them indicated that the usage can be of great value, but they have difficulties with putting it into practice. In addition to that, there is not enough awareness of the potential and the positive influence that the app has. This leads to a situation in which the wards are not captivated in the innovations that are currently developed inside DWP.

Secondly, the degree of treatment compliance of the clients was evaluated with the employees. This was done by asking randomly chosen employees the following question: ‘How often do clients comply to their treatment appointments?’. The answers that were given are shown in Figure 12.

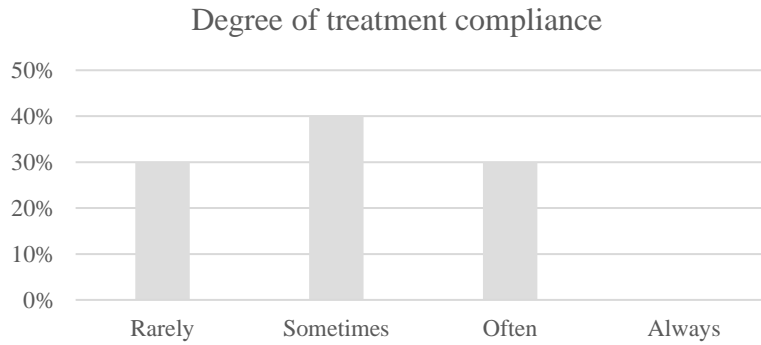


Figure 12. Degree of treatment compliance from the employees' point of view.

It can be concluded that most employees indicated that the degree of treatment compliance is very low. None of the employees indicated that the clients always comply to their treatment appointments. In addition to that, 70% of the employees indicated that clients rarely or sometimes comply which is a very low degree of treatment compliance. As stated earlier, compliance is one of the most important factors in achieving desired medical outcomes (Jin et al., 2008). Therefore, a solution needed to be provided to DWP that could help them motivate the clients to comply to their treatment.

The problem was also validated with the clients. The clients that were used for this validation were the clients that participated in the pilot. Firstly, the clients were asked how often they have used the HKT-app in the past. This was compared to the duration of the hospitalization of that specific client to make the results more meaningful. This resulted in the following numbers:

Table 3. Frequency of HKT-app usage among clients.

| Duration of hospitalization | Respondents | How often used total | Mean per year |
|-----------------------------|-------------|----------------------|---------------|
| ≤ 1 year                    | 3           | 5                    | 1.7           |
| > 1 year, ≤ 2 years         | 3           | 6                    | 1             |
| > 2 years, ≤ 3 years        | 1           | 3                    | 1             |
| <b>Total</b>                | <b>7</b>    | <b>14</b>            | <b>1.2</b>    |

From Table 3 it could be concluded that, on average, a client fills in their HKT-app 1.2 times per year. An important note is that the group of pilot participants was probably even more engaged in using eHealth applications than the average client inside DWP. The participants could choose personally whether they were participating in the pilot. Most of them participated since they were interested in eHealth applications and therefore, the mean HKT-app usage was probably lower among the entire population. The HKT-app should at least be filled in 2 times per year. Therefore, it could be concluded that the frequency of HKT-app usage among the pilot participants was too low. And consequently, it was probable that the usage of the HKT-app of the entire population was even lower than the 1.2 times per year. An interesting point of attention is that the frequency of the respondents that have a duration of hospitalization less than 1 year is the highest. A possible explanation for this is that in the first year, the clients fill in their HKT-app. After this first year they experience a low degree of support from the employees and they stop filling in their HKT-app. This explanation was also validated by the participants that have a hospitalization longer than one year. They indicated that their total frequency of usage was merely due to their first year of hospitalization.

The second question that was asked to validate the problem was as follows: 'What is your current degree of motivation to comply to your treatment program?'. Figure 13 shows the answers that were given to this question.



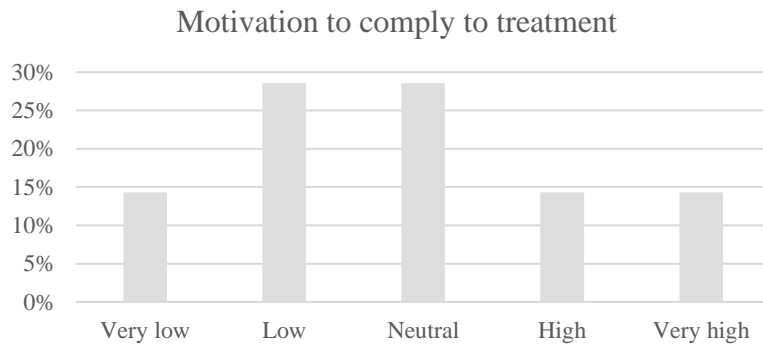


Figure 13. Motivation to comply to treatment at the start of the pilot.

Figure 13 shows that from the 7 clients that were participating in the pilot, only 2 of them score their motivation as ‘high’ or ‘very high’. The other 5 clients score their motivation to comply to treatment as ‘neutral’, ‘low’ or ‘very low’. This implied that the average motivation to comply to treatment is not very high among the clients.

So in conclusion, it was verified by both employees and clients that the current usage of the HKT-app is too low. The employees indicated that they need more support in using the HKT-app on a daily basis and the clients notified that more support from the employees would be very helpful. In addition to that, the motivation to comply to treatment was scored relatively low. Now that the problems were validated, the causes of the problem needed to be investigated in more detail.

#### 4.1.2. Causes of the problem

The causes of the problem are represented with the use of an Ishikawa Diagram (also known as Fishbone Diagram or Cause and Effect Diagram). The Ishikawa diagram is an analysis tool that makes it possible to look systematically at effects and the causes that create or contribute to that effect (Ilie & Ciocoiu, 2010). The diagram that was created for systemizing the problem that DWP is facing is shown in Figure 14.

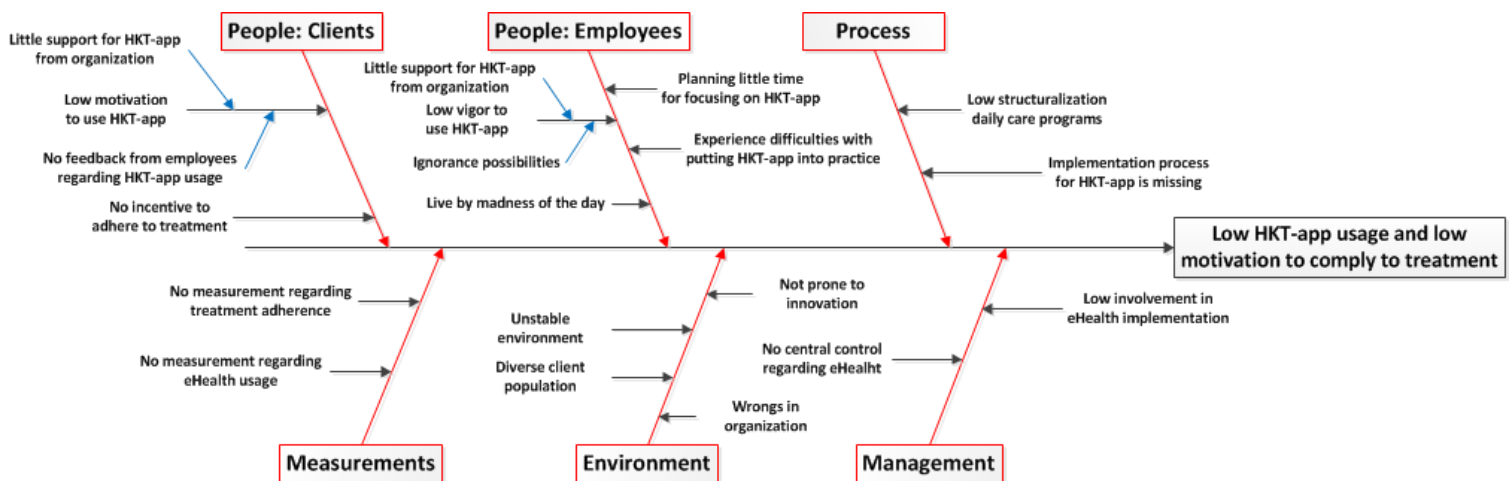


Figure 14. Fishbone diagram of problem.

The fishbone diagram shows that the problem can be split up in 6 different main categories (red), 16 primary causes (black) and 4 secondary causes (blue). When the causes are evaluated, the main problem is that there is not enough support and control regarding HKT-app usage and treatment compliance. Currently, there is no incentive for the clients to comply to their treatment because there are little to none consequences when they are not complying to their daily treatment program nor

positive feedback is given when they are complying to their treatment. In addition to that, they are not motivated by the employees to use the HKT-app because the employees have little vigor and knowledge on how to use the application and they do not schedule time to increase their knowledge and skills regarding the usage. This is mainly due to an unstable environment and a lack of clear instructions, processes and measurements regarding eHealth implementation and usage. This leads to a situation in which the employees encounter difficulties with putting the HKT-app into practice.

#### **4.1.3. Validation of causes and their importance**

The diagram that is shown in Figure 14 was accomplished by asking employees whether they agreed with the diagram and whether they had any additions to the developed Fishbone diagram. Thus, the creation of the diagram was an iterative process in which the initial diagram was adapted with the use of the given feedback from an employee. This led to a new diagram which was evaluated again with an employee and so on. This was done until no meaningful new additions were given by the employees. In this manner, the problems were validated by the employees since it was based on their personal feedback.

The relative importance of each of the causes could be identified with the usage of different criteria. It was chosen to map their importance as the extent to which this master thesis project could provide a solution for the problem. Changing the environment and management did not fall within the scope and possibilities of this master thesis project. However, the other causes might be of importance for this project. The following causes were taken into account: low motivation/vigor to use the HKT-app, no incentive to comply to treatment, low structuralization daily care programs, no measurement regarding treatment compliance and strong difficulties with putting the HKT-app into practice. The development of the GameBus challenges was positively contributing at least in some degree to all of these causes.

#### **4.1.4. Conclusion**

So in conclusion, the results of the diagnosis phase showed that the situation that was outlined in the introduction is a significant problem. Both employees and clients indicate that their usage of the HKT-app is (too) low. This is largely caused by the fact that employees have difficulties with putting the HKT-app into practice. After the HKT-scores are discussed with the client, they have no guidelines in using these results in the daily treatment program of the client. The client in turn has the feeling that there is little to no support from the employees and they stop using the HKT-app. This is a shame, because the HKT-app has great potential in increasing the treatment quality and progression of a client. When GameBus can provide a practical tool that supports the step of putting the results of the HKT-app into practice, DWP can experience substantial improvements in the usability of the app. In addition to that, GameBus has the possibility to motivate and monitor the clients in complying to their treatment. Before this can be done, it should be investigated which design decisions in GameBus work best inside DWP. When this is known, the support tool can be developed as a second step. Before these steps could be executed, a small literature review was performed that investigated the current developments in designing gamification for increasing motivation.

## **4.2. Successful gamification design**

This section is answering the second sub-question that was formulated as follows: *What information can be retrieved from available literature and GameBus regarding successful gamification design for increasing motivation and providing an enjoyable game experience?* This question was investigating the best practices for designing successful gamification interventions. The results from this investigation were used for deciding which different types of design were implemented and evaluated during the pilot study. Firstly, a short description will be given regarding the current

developments in the field of gamification design. Consequently, these developments will be translated to the design space of GameBus. Finally, an overview will be given regarding which design decisions were implemented.

#### 4.2.1. Current developments in the field of gamification design

Technology is entering a new frontier in which personalization of technology is a great area of interest (Bert, 2017). Personalizing technology is the process of tailoring the technology to individual users' characteristics and preferences. In this way, the individual needs can be met more effectively and efficiently which can lead to more positive attitudes towards the technology and positive behavioral change. These developments are also taking place within the research field of gamification. This so called 'personalized gamification' is about improving the traditional gamification approaches by adding user-centered, personalized and adaptive game mechanisms, adjusted to the characteristics of a specific user and the contexts (Böckle et al., 2017). Currently, little is known about successfully adapting gamification to the individual needs of a user. For example, when we refer back to the earlier mentioned 'Gamification 3.0', it was concluded that until now not much gamification initiatives have focused on this personalized gamification. Fortunately, other research areas such as advertising are already one step further in adapting technologies to specific users. A promising direction in adapting gamification to personal needs is the use of persuasion profiling (Kaptein et al., 2015). Persuasion profiling uses explicit and implicit measures of the users to adapt the technology to their personal wants. Using persuasion profiling in gamification can be of great value since it will use data of the users to improve the application which will increase the personalization of gamification. This type of iteratively improving the design based on information from the users will be used in this master thesis as well. It will adapt the current design of GameBus on the basis of actual responses of the pilot participants accompanied with small questionnaires and personal data. The first type of measure is categorized as an implicit measure and is merely focused on increasing the usability of a system while the second measure can be categorized as an explicit measure (Kaptein et al., 2015).

#### 4.2.2. Personalizing GameBus inside DWP

The current developments in the field of gamification design show that there is a need for adapting gamification to the individual user needs. Therefore, this master thesis will focus on this personalization by investigating the user perceptions of different design decisions. In this way, the best design inside GameBus can be further improved such that it is adapting to the personal wants. These design decisions were based on the possible design space that GameBus has. This design space was developed by walking through the challenge design process in GameBus and by reviewing the possible decisions that can be made during this process. These design decisions or parameters are the dimensions of a design where choices can be made to define the artefact (Reymen, 2014). The challenge creation process is visualized with the usage of GameBus screenshots in Appendix H. From this process, 3 main steps can be retrieved. The first step is the creation of a team, the second step is the creation of the challenge in terms of general challenge information. The last step is the creation of the challenge in terms of activity specific information. Table 4 shows the decision parameters per step and which of them will be controlled and which of them will be varied during this master thesis project.

*Table 4. Design parameters in GameBus.*

| <b>Step</b>          | <b>Design decision parameters</b> | <b>Controlled or experimented</b> |
|----------------------|-----------------------------------|-----------------------------------|
| <b>Team creation</b> | Team name                         | Controlled                        |
|                      | Team type                         | Controlled                        |
|                      | Team size                         | Controlled                        |

|                                      |                            |               |            |
|--------------------------------------|----------------------------|---------------|------------|
| <b>General challenge information</b> | Number of challenges       | Experimented  |            |
|                                      | Challenge name             | Controlled    |            |
|                                      | Challenge description      | Controlled    |            |
|                                      | External information page  | Controlled    |            |
|                                      | Reward                     | Controlled    |            |
|                                      | Challenge beginning        | Controlled    |            |
|                                      | Challenge deadline         | Controlled    |            |
|                                      | Challenge visible from     | Controlled    |            |
|                                      | Review automatically       | Controlled    |            |
|                                      | Team size inside challenge | Controlled    |            |
|                                      | Type of challenge          | Controlled    |            |
|                                      | <b>Activity specifics</b>  | Activity name | Controlled |
|                                      |                            | Activity type | Controlled |
| Activity score                       |                            | Experimented  |            |
| Activity condition                   |                            | Controlled    |            |
| Add new activity in challenge        |                            | Experimented  |            |

As can be seen in Table 4, much of the design parameters were controlled during this master thesis project. Some of them were controlled because they were not meaningful for the challenge design process in this project. An example of this is the team name decision. This decision probably would have no effect on the motivation of clients to adhere to treatment and was thus not of importance in this study. Other variables are controlled because only then we could say something about a causal effect of the design decision on the outcome variables. For example, when the team size would be changed during each iteration, it could be the case that this would influence the outcome variables in addition to the experimental variable. As can be seen from the table, three design parameters were varied during this master thesis project. These parameters were chosen because they are the most important in adapting GameBus to the user's personalities, emotions, habits and activities such that it would be related to each participant's situation (Gadiyar, 2014) and thus increase the personalization of gamification. The controlled and experimented design parameters are described in more detail in the next sections.

#### ***4.2.2.1. Overview of controlled design parameters***

From Table 4, a number of important design parameters that were controlled in this research need some explanation. The important controlled design decisions are: team size, reward, challenge duration (time between beginning and deadline), team size inside challenge and type of challenge. It was assumed that the other control variables were less important in investigating the effects of different design decisions on the user's motivation. The team size will be fixed during the pilot period and will be equal to 7 users. The reward will be relative to the duration of the challenge. The challenge duration will be either 3 or 4 weeks per design decision. The team size inside the challenge will be equal to one person per team. This means that the users will perform activities for them personally and not for a team. Lastly, it was decided to use a Top X challenge type. This means that a X number of winners will be chosen at the end of the challenge. It was decided to use a Top 1 challenge which means that the number 1 on the leaderboard received the reward at the end of the challenge. More explanation for these controlled parameters in terms of how they were set per design type is given in chapter 5.

#### ***4.2.2.2. Overview of experimental design parameters***

First of all, the general idea of UHG in GameBus will be tested. This was done by making two sub-challenges. The first challenge took a traditional approach by making it impossible to compete

against each other by performing different activities. The second challenge in turn made it possible to compete against each other by performing different activities which is in line with the UHG approach. This design decision is experimenting with the design parameter 'number of challenges'. Secondly, the personalization in terms of activities was implemented in the GameBus challenge, which is about varying the design parameter 'add new activity in challenge'. Lastly, the personalization in terms of scoring systems was evaluated with the users. This last decision was changing the 'activity score' design parameter on the activity specifics level. This challenge will thus not be tested during the pilot, but will only be evaluated on the perceived usefulness which will be discussed in chapter 7. This decision was made because of the time constraints that are set to the master thesis project.

This research thus will contribute to the current research gap by investigating different types of personalized gamification and their effects on motivation and perceived fun and fairness. In addition to that, it was investigating a possible solution for the problem that DWP is facing regarding the low treatment compliance rates and the low usage of the HKT-app.

#### **4.2.3. Conclusion**

In conclusion, this master thesis will investigate the personalization of gamification by applying and testing different design decisions in GameBus. After each design iteration, the decision could be made to expand or abandon the previous tested design on the basis of the responses of the pilot participants. In other words, it will adapt the current design of GameBus on the basis of actual responses of the pilot participants (implicit measure) accompanied with small questionnaires and personal data (explicit measures). This is based on the knowledge that persuasion profiling enhances the adaptation of gamification to the user's needs. These designs will vary in terms of non-unified versus unified design and non-personalized versus personalized design. These designs will be implemented in a small pilot study which has the goal to find out which design of GameBus achieved the highest motivation to comply to treatment inside DWP. The last challenge design will only be evaluated with the pilot participants and with a number of employees of DWP. The set-up of these designs is discussed in chapter 5. The accompanied results will be described in either chapter 6 or chapter 7.

## 5. Design

In this phase, different decisions needed to be made that were aiming at answering the sub-research question in this stage which was as follows: *How can the information from the diagnosis phase be used to develop a successful GameBus challenge?* This research question was answered with the use of smaller sub-questions. These sub-questions will be discussed below and afterwards, a general conclusion will be given that is answering the main research question of this phase. First, the basic design challenge decisions will be discussed. Afterwards, a description of the different design decisions that were implemented during this master thesis will be discussed. Finally, a complete overview of the design decisions will be summarized in a table in which the design parameters per design type will be shown.

### 5.1. First basic challenge decisions

From the diagnosis phase it was concluded that there are multiple promising directions in gamification design decisions that can be of great value in increasing the motivation of clients to comply to treatment and at the same, giving DWP the possibility to review the activities of a client. Before these design decisions will be described in detail, a few basic challenge decisions needed to be made that served as the basic challenge. These basic challenge decisions could be retrieved from the controlled design parameters that were described in 4.2.2.1. The decisions that needed to be made were which activities should be implemented in GameBus during the pilot as a first basis, which scoring system should be used for these activities, the type of activity registration policy, team size, reward, challenge duration (time between beginning and deadline), team size inside the challenge and type of challenge. The first three decisions need more explanation, the other controlled design parameters were already discussed in the previous chapter. Therefore, an explanation for the first three decisions will be given in the next sections. In addition to that, the chapter will close with an overview of the values of all controlled design parameters such that it is known how these parameters differ or are fixed per design type.

#### 5.1.1. Activities

The first important decision that was made in the design phase was which activities should be added in GameBus during the pilot. These activities were chosen with the help of domain experts within DWP. Because this master thesis was looking for a gamification implementation that would stimulate clients to use the HKT-app and to comply to their treatment activities, it was a logical first step to look for activities that could be linked to the risk factors of the HKT-app. For each risk factor that is given in Figure 3 two activities were chosen. The activities that were chosen are given in Table 33 in Appendix H. This table gives a total of 28 activities from which one is mentioned two times ('Comply to your weekly treatment schedule'), which gives 27 unique activities. In addition to that, the usage of Minddistrict is mentioned very often. Since every client can perform different types of modules, trainings and diaries, the decision was made to generalize all Minddistrict activities to 'Use Minddistrict'. When this criterion is applied a total of 18 unique activities remained.

Since this master thesis was focusing on conducting a small-scale pilot a selection of 7 activities was made that were divided in 4 main challenges to keep it manageable in the available time. This selection was done with the use of two criteria. Firstly, the activities that were linked to the top 5 risk factors in De Woenselse Poort were weighted double. The top 5 risk factors is as follows (in descending order): 1) Addiction, 2) Coping skills, 3) Impulsiveness, 4) Problem understanding and 5) Labor skills. Secondly, the activities that were chosen should cover as many risk factors as possible. One could imagine that some of the activities were covering not only the risk factor to which they were linked. For example, 'participate in sports' is not only good for hostility but also for coping skills, (anti)social

behavior and addiction (Wijndaele et al., 2007). On the basis of these criteria an evaluation was done regarding which 7 activities should be implemented. The evaluation of the activities can be found in Table 34 in Appendix J. From this table, it can be concluded that the 4 challenges should include: 1) Participate in labor, therapy, training or education, 2) Usage of Minddistrict, 3) Fill in your agenda on your iPad, and 4) Participate in sports. When these activities are chosen there is a total coverage of 14 out of 14 risk factors. This means that by performing these activities all risk factors could be covered, depending on whether a client engages in all challenges and which specific modules, trainings or diaries are used in Minddistrict.

### 5.1.2. Scoring system

Secondly, a decision was made regarding the scoring values that were assigned to the activities. The points that were awarded needed to take different important aspects into account. First of all, the scores needed to be fair. Secondly, activities that were valued as important for DWP as an organization were scored relatively high in comparison to the other activities. This relative importance was assessed by using knowledge of domain experts. The last consideration that was taken into account was that the time that was spent on an activity had to be in proportion to the points that were assigned to that activity. These considerations led to the following scoring values for each activity.

**Sports.** A small literature review had been performed on whether the frequency of sport was associated with higher performance and better health results. In addition to that, it was reviewed whether there was a threshold frequency of sport participation that needed to be scored higher. It was found that increasing performance and health results is not so much related to the frequency of sport, but more to the total amount of weekly exercise (ACSM, 2017). The guidelines state that adults need moderate-intensity aerobic physical activity for a minimum of 150 minutes a week or vigorous-intensity aerobic physical activity for a minimum of 60 minutes a week. In addition to that, muscular strength and endurance training should be performed at least two times a week. When people want to improve their personal fitness, exceeding the minimum recommended amounts of physical activity can be beneficial (Haskell et al., 2007). Since the clients have fixed time blocks for sports, the decision was made to score every time they exercise with equal points.

**Labor, therapy, training and education.** Both labor, therapy, training and education have the same structure as the sports blocks. Each day, different fixed time blocks can be used for participating in labor, therapy, training and/or education. Therefore, the decision was made to score every time they participate in a time block with equal points.

**Agenda.** Scoring the agenda activity was more complicated, because there is no clear cut off whether the agenda was filled in correctly or not. Taken this into account, the participants received the points when they were showing their agenda during the weekly meetings and when they showed that they had an up-to-date agenda and had a clear overview of their duties in the upcoming week.

**Minddistrict.** Minddistrict usage is a very important activity in DWP. The reason for this is that it is a very powerful tool for more personal control in the treatments of the clients and because DWP has set the target to stimulate eHealth usage. As stated before, different components are available in the platform, namely online modules, trainings, diaries and conversation functions (Minddistrict, 2017). Each of these components require different amounts of time, effort and concentration. Thus, it was a logical choice to score each of these components differently. Moreover, because Minddistrict was seen as very important, the decision was made to score these activities proportionally higher than the activities that are not making use of eHealth applications.

Summarizing, the points that were awarded for each activity are shown in Table 5.

Table 5. Overview scoring values GameBus challenge.

| Activity                               | Scoring system                                   |
|--|--|
| <b>Sports</b>                          | + 5 points for every participation in sports     |
| <b>Labor</b>                           | + 5 points for every participation in labor      |
| <b>Therapy</b>                         | + 5 points for every participation in labor      |
| <b>Training</b>                        | + 5 points for every participation in training   |
| <b>Education</b>                       | + 5 points for every participation in education  |
| <b>Agenda</b>                          | + 15 points for a completely filled in agenda    |
| <b>Minddistrict: Modules/Trainings</b> | + 20 points for every registered module/training |
| <b>Minddistrict: Diary</b>             | + 15 points for every weekly registered diary    |
| <b>Minddistrict: Conversation</b>      | + 10 points for every registered conversation    |

An important note is that this scoring system was used as a first basis for the challenges. Changes could still be made after each decision moment in the research process in Figure 7.

### 5.1.3. Activity registration

Activity registration could be done in two different ways. The first possibility was that the clients registered their activities manually and personally each week. The second possibility was that the activities would be registered on the basis of the activities that were registered in their personal health record. This would lead to an automatic registration which decreased the amount of effort clients should put in registering their activities in GameBus. Both registration options had their pros and cons. Registration by the clients led to more involvement in the challenge and in the usage of GameBus. However, it could be seen as annoying when they had to register all activities manually because it could be seen as time consuming and a lot of effort. Automated registration, on the other hand, could lead to a low engagement in GameBus usage. But the advantage of this was that it decreased the time that clients had to spent on completing the registration of activities in GameBus on a weekly basis. This would decrease the possibility that clients discontinue using GameBus because of a too high level of effort.

The pros and cons considered, the best option was to use a combination of both manually and automatically registration. One activity that could only be registered manually is whether the agenda on the iPad is filled in. This activity could not be checked remotely, so this activity was registered manually on a weekly basis. During this weekly registration, it was checked whether the agenda on the iPad was filled in properly. The other activities were registered automatically by reviewing the activities that were registered in their personal health records.

## 5.2. Design types

From the diagnosis phase it was concluded that there are some gaps in the available literature regarding successful gamification design. These gaps are mainly a consequence of a limited number of implementation studies. This pilot increased the knowledge of designing successful gamification interventions by reviewing the effects of different design decisions. This section will answer the sub-research question: *Which different design decisions can be applied in developing GameBus challenges?* Firstly, the novel approach of GameBus to gamification called UHG will be evaluated. Afterwards, the personalization of gamification both in terms of activities and scoring systems was evaluated by using the sub-research question: *Which data is available and can this data be used to optimize the GameBus*



*challenges in terms of activities or scoring systems?* An important note is that the personalization in terms of activities was tested during the pilot and the personalization in terms of scoring systems was evaluated with the use of interviews with both clients and employees.

### **5.2.1. First design – non-unified versus unified**

The first design decision that was investigated is whether the clients value the possibility to challenge each other by performing different types of activities. Testing the value of UHG was done by making two different designs. The first design, named non-unified design from now on, consisted of separate challenges for each activity. The second design, named unified design from now on, implemented one big challenge for all the activities together. The non-unified design was tested in the first two weeks of the first challenge implementation phase while the unified design was tested in the last two weeks of the first challenge implementation phase.

### **5.2.2. Second design – personalization in terms of activities**

The second design adapted the activities that were implemented in GameBus based on the intermediate interviews. During the first 4 weeks, it was noticed that clients frequently asked why the decision was made to include or not include certain activities. The activities that were chosen in the first 4 weeks were based on conversations with domain experts inside DWP, but the real needs and opinions of the clients were left out of the first decision moment. However, their feedback was used in the second design to improve the GameBus challenge. Taken into account the opinions and needs of the clients increased the personalized experience of the users. Therefore, the data that was used for optimizing this design was retrieved from the interviews with the clients. For each participant, a certain activity was added that was seen as valuable to them.

Besides adapting the activities in the challenges on the basis of personal preferences, the implementation of the first design decision resulted in the knowledge whether the clients preferred the non-unified or unified design. This result was taken into account and the second design continued with the preferred design option. These two adaptations to the GameBus challenge resulted in an increase in personalization for clients inside DWP.

### **5.2.3. Third design – personalization in terms of scoring systems**

The third design was aiming at improving the scoring system of GameBus. Currently, GameBus uses a so called linear scoring system. This means that for each activity that is performed, the same amount of points is assigned to this activity. However, research has shown that scoring systems can have a big influence on the pleasure of the users during the game. There is a growing complexity of scoring systems which shows the importance of establishing the degree to which the type of scoring system affects player satisfaction. Scoring systems are useful for self-assessment and comparison. It can strongly influence the user satisfaction toward the game. It is a way of measuring success and it can indirectly influence gameplay provided that there is a clear understanding of how the system influences satisfaction (Lee et al., 2016). Scoring systems thus might have a big influence on the perceived relatedness, autonomy, competence, fun and fairness of users. The importance of a scoring system implies that GameBus might want to reconsider the current system by developing so called ‘smart scoring systems’. This implies that based on personal characteristics and activity types of the clients, different scoring systems could be applied in a challenge. Different scoring systems were created to evaluate and to investigate their benefits and drawbacks. An overview of the different variations that were investigated are shown in Table 6. A visual representation of each scoring system is given in Figure 33 to Figure 39 in Appendix K.

Table 6. Overview of investigated scoring systems.

| Scoring System                                      | Explanation  |
|---|--|
| <b>Linear</b>                                       | For each time an activity is performed, the same amount of points is assigned  |
| <b>Increasing</b>                                   | For each time an activity is performed, an increasing amount of points is assigned   |
| <b>Decreasing</b>                                   | For each time an activity is performed, a decreasing amount of points is assigned  |
| <b>Baseline improvement</b>                         | When an activity is performed more often than a certain baseline, points are assigned to that activity   |
| <b>Maximum daily/weekly score per activity</b>      | For each activity, points are assigned provided that it is not exceeding the total daily/weekly limit  |
| <b>Completion of personal goal</b>                  | When a personal goal is achieved in terms of how often an activity must be performed a certain percentage bonus points is assigned             |
| <b>Importance factor based on clinical taxation</b> | For each activity, the assigned points are multiplied by a factor based on the clinical taxation scores of a client (HKT-app in this research) |
| <b>Adjustment on previous leaderboard</b>           | Based on the leaderboard of the previous week, the users get adjusted points   |

The different types of scoring systems were evaluated by interviewing both the participants of the pilot and employees of DWP. Since the pilot resulted in different leaderboards, it was possible to adjust the scores of the clients and showing them the ‘new’ leaderboards. This made it possible for them to judge the new scoring systems in terms of whether they would be more satisfied with the adjusted scores and their place on the leaderboards. The evaluation of the leaderboards by the employees was done with the use of personas. This is further described in section 7.2.2.1.

### 5.3. Design checklist

A design checklist was used to make sure that all designs were the same as much as possible. This decreased the chance that one design was preferred over another design because of certain design decisions and not because of the fact whether it was unified or non-unified and whether it was personalized or non-personalized. This design checklist was derived from the domain-independent descriptive design model of Reymen et al. (2006). In this checklist, different important aspects are taken into account when one is in the design step of the regulative model cycle of van Strien (1975). First of all, the design constraints were defined. Secondly, requirements were drawn up on which the designs were scored for the final evaluation. Afterwards, the design parameters were defined that were of importance for this research.

#### 5.3.1. Constraints

The design constraints could be divided in boundary conditions and design restrictions. The boundary conditions concerned the undiscussable boundaries of the solution. The design restrictions are the restrictions that the designer determines when executing the implementation (Reymen, 2014).

The most important boundary conditions were the restrictions that were set to the clients in DWP. They did not have access to the internet when they are in their room. In addition to that, they do not have a smartphone or tablet on which GameBus could be downloaded. These restrictions were merely solved by registering their activities automatically and by giving them the possibility to register their agenda activity on a weekly basis.

The design restrictions that were set to this master thesis were mostly focusing on time and money restrictions. Since the master thesis project timespan ranges from 21 to 25 weeks which includes the development of the research proposal and master thesis project, the timespan of the pilot study could not take too long. In addition to that, it was desired to reward each winner of a challenge. The best suitable price turned out to be a gift card after each iteration. The reason for this was that there are strict rules inside DWP regarding what one can give to clients and what one cannot give to clients. Because of these restrictions, the best suitable price was to give a gift card. Since the amount of available money was limited in this research the amount of money per challenge could not be too high. One could argue that rewarding clients with money had its downsides. However, research has shown that rewarding good performances does not decrease intrinsic motivation. Rewards are negatively affecting motivation when participants are just simply rewarded for doing the activity. Since the rewards were only given to the best performing participants and since it was combined with verbal feedback and praise during the weekly meetings it could be assumed that it did not have a negative effect (Cameron & Pierce, 1994). In addition to that, most of the clients indicated that they were playing for their own good and not so much because of the monetary rewards.

### 5.3.2. Requirements

Different requirements were important for deciding which design worked best for motivating the clients in DWP to comply to their treatment. The following requirements were taken into account: relatedness, autonomy, competence, treatment awareness, motivation, fun and fairness. All these requirements received an importance score ranging from 1 (not very important) to 3 (very important) such that some requirements were valued as more important in the decision table. All designs scored on each requirement with a value between 1 (not met) to 3 (completely met) and these values were multiplied with the importance score. In conclusion, these requirements and their scores formed a decision-making table from which the best design could be derived. The template of this table is shown in Table 35 that is added in Appendix L.

The support for using these requirements was as follows. The first five requirements were derived from the model that formed the basis for deciding which design worked best in motivating the clients in DWP to comply to their treatment. This decision was thus a logically one since these are the most important variables in this research. In addition to that, the fun and fairness requirements were important to deliver an enjoyable game experience for the clients. Besides these requirements, it was possible that during the evaluations some aspects came to light that the clients perceived as important requirements. Therefore, the requirement table could be further extended on the basis of valuable input from the pilot participants.

### 5.3.3. Design parameters

Lastly, but very important, were the design parameters. The design parameters were already discussed in 4.2.2.1 and 4.2.2.2. However, they need more explanation in terms of the assigned values in each design decision. A short summary of the design parameters is given below in Table 7.

*Table 7. Overview design parameters per design type.*

| <b>Design parameter</b>            | <b>Non-unified</b> | <b>Unified</b> | <b>Personalized -<br/>Activities</b> |
|------------------------------------|--------------------|----------------|--------------------------------------|
| <b>Scoring system per activity</b> |                    |                |                                      |
| Sports                             | + 5 at a time      | + 5 at a time  | + 5 at a time                        |
| Labor                              | + 5 at a time      | + 5 at a time  | + 5 at a time                        |
| Education                          | + 5 at a time      | + 5 at a time  | + 5 at a time                        |

|  |   |   |   |
|--|---|---|---|
| Training                               | + 5 at a time                                 | + 5 at a time                                 | + 5 at a time                                 |
| Therapy                                | + 5 at a time                                 | + 5 at a time                                 | + 5 at a time                                 |
| Agenda                                 | + 15 weekly                                   | + 15 weekly                                   | + 15 weekly                                   |
| MD: Module/training                    | + 20 at a time                                | + 20 at a time                                | + 20 at a time                                |
| MD: Diary                              | + 15 at a time                                | + 15 at a time                                | + 15 at a time                                |
| MD: Conversation                       | +10 at a time                                 | +10 at a time                                 | +10 at a time                                 |
| <b>Activity registration</b>           | Automatically, except for the agenda activity | Automatically, except for the agenda activity | Automatically, except for the agenda activity |
| <b>Team size</b>                       | 7   | 7   | 7   |
| <b>Reward</b>                          | 4 x €5,-                                      | 1 x €20,-                                     | 4 x €5,- and 1 x €10,-                        |
| <b>Challenge duration</b>              | 2 weeks                                       | 2 weeks                                       | 3 weeks                                       |
| <b>Team size inside challenge</b>      | 1   | 1   | 1   |
| <b>Type of challenge</b>               | Top X (Top 1)                                 | Top X (Top 1)                                 | Top X (Top 1)                                 |
| <b>Number of challenges/winners</b>    | 4   | 1   | 5   |
| <b>Add new activities in challenge</b> | No  | No  | Yes   |
| <b>Adapt scores per activity</b>       | No  | No  | No  |

As can be concluded from Table 7, the controlled design parameters were the same or relative to the values of the other designs. This was reducing the possibility that the findings during the implementation were a consequence of very different design parameters and not because of different types of design decisions. In other words, fixing most of the design parameters made it possible to make the experiment valid for assessing the differences between the 3 experimental design parameters. Now that every design was specified in detail, the different designs were tested by the pilot participants. The findings from this pilot are described in the next chapter.

Before continuing discussing the results from the implementation of the GameBus challenges, a small overview is given in which the different types of design decisions are visualized. This overview is given in Figure 15 and serves as a supporting overview in going through the implementation results.

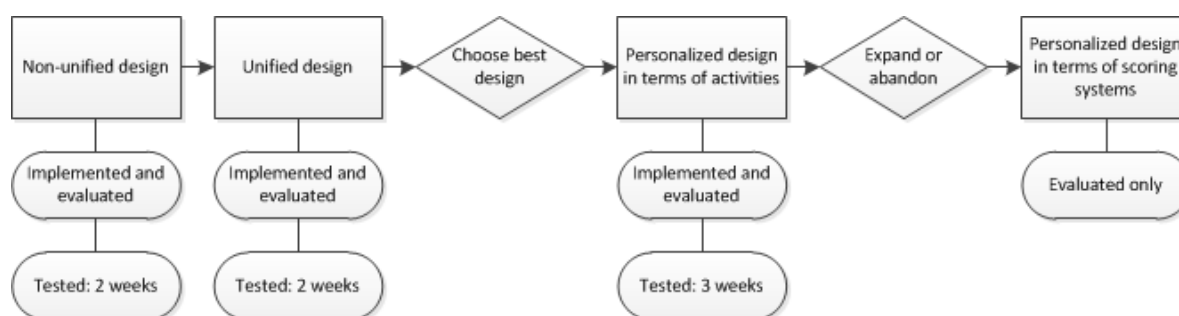


Figure 15. Overview of the different tested designs.

## 6. Implementation

This phase discusses the experiences of the pilot participants of each implemented GameBus design. In other words, it is answering the research question that was formulated for the implementation phase. This question was as follows: *Which GameBus design achieves the highest motivation to comply to treatment of clients in DWP and satisfies the dimensions of fairness and fun?* This question was split up in two smaller sub-questions that were evaluating the non-unified versus unified design and the personalized design. An important note is that the pilot study was merely focusing on feasibility, not on statistical significance (Thabane et al., 2010). This implied that the pilot's main aim was to investigate whether the clients perceived GameBus as a valuable app for treatment compliance motivation. In addition to that, the different designs were investigated and assessed on highest motivational effects, fairness and fun. This question was answered with the use of both quantitative and qualitative data that was retrieved from the intermediate interviews and questionnaires and post-test interviews and questionnaires. Based on the collected results, each decision moment that is shown in Figure 7 could be supported and the overall user experience of GameBus could be investigated. This was done such that the proposed hypotheses that were formulated in section 3.2.3 could be checked. Screenshots of each challenge and the accompanied final leaderboards can be found in Appendix M.

This chapter is structured as follows. First, the findings from the first four pilot weeks will be discussed in which the non-unified and unified design were tested. Secondly, the experiences of the personalized design will be discussed which will be followed by a comparison between the non-personalized designs (non-unified and unified) and the personalized design. Afterwards, the general findings regarding GameBus usage will be given. Finally, the chapter will close with a general conclusion.

### 6.1. Non-unified versus unified design

The first four weeks of the pilot were focusing on investigating whether the clients preferred the non-unified or unified design in GameBus. This evaluation was used to be able to make the first decision that is shown in Figure 7. The main differences between the non-unified and unified experiences could be explained by motivation, fairness and fun. Additionally, something interesting happened at the end of the interview. These findings are described in 6.1.3.

#### 6.1.1. Motivation

The clients felt more motivated when they were able to see their score for each activity separately. This opinion was shared among all participants. This was caused by a greater clarity about which activities they had performed and how they were scoring on each of these activities. They appreciated the overview that they had of each activity in the non-unified design. This finding can be explained by the Goal-Setting Theory of Locke and Latham (1994). This theory states that when a person sets a goal accompanied with a clear structure that directs action towards that goal, a person will be more motivated in achieving this goal. Since the unified design made it hard for clients to see which exact activities they had performed they could not set a specific goal for each activity separately. This made it hard for them to direct attention to the behaviors needed to accomplish their own goals which harmed their motivation (Latham, 2004). Some components of the SDT were seen in the answers as well. The participants perceived a higher degree of autonomy since they were able to choose personally in which activities they wanted to excel without being punished by seeing no results of this choice on the unified leaderboard. In addition to that, the participants also had a greater sense of competence when they were able to see how they were performing on each activity separately. Some statements that were given to support the conclusion above are described below:

*“I prefer to score well on one activity and then it doesn’t matter to me if I am the overall winner or not” (Client ID 1, male, 35 years)*

*“I think that when you want to motivate clients to do specific activities they need an overview of each activity separately” (Client ID 2, male, 30 years)*

*“It is very demotivating for me when I cannot see which activities I have performed well” (Client ID 7, male, 25 years)*

*“I am more motivated when I can focus on my own activities and I don’t have to be the overall winner” (Client ID 3, female, 31 years)*

*“It was very unclear how you had scored your points when you only had the big leaderboard, this makes it hard to improve yourself” (Client ID 5, male, 44 years)*

*“I am more challenged when I can see where I battle for” (Client ID 6, male, 27 years)*

### **6.1.2. Fairness and fun**

A higher perceived value of fairness was achieved in the non-unified design as well. The main reason for this was that the clients thought that they had a higher chance of winning challenges in the non-unified design. An important characteristic of fairness, as stated in 2.3.3, is about equality of opportunity (Gilbert, 2013). Each player should have an (almost) equal chance of winning the challenges. From the final leaderboards of the first two challenges, it could be seen that there was one extremely active client. This made it in the unified design impossible for some players to win the challenge, which harmed the perceived fairness of the users. Additionally, an important characteristic for fun was that the players should have a sense of mastery and choice (Ventrice, 2011). Since the unified design made it hard for the players to see how well they were performing and gave them no opportunity to excel at specific activities this deteriorated the perceived fun of the pilot participants. Some statements that were given to support this claim are:

*“In the unified design, I had no chance of winning anything right from the start” (Client ID 4, male, 29 years)*

*“Suppose that you are not performing well on two activities and you are performing very well on one activity you will not be rewarded for this” (Client ID 7, male, 25 years)*

*“The first design made it possible to choose personally which activity you wanted to do well” (Client ID 1, male, 35 years)*

*“When you want to excel on one activity you do not have a chance to win when there is only one big leaderboard, this is not fair” (Client ID 2, male, 30 years)*

*“The small challenges made it more fair and there were more chances to win than when there is only one big challenge” (Client ID 6, male, 27 years)*

Some statements that were already indicating future improvements for the challenge design were:

*“It would be a good idea if people from Poort would be able to perform different activities than the ones that are currently possible in the challenges” (Client ID 1, male, 35 years)*

*“If you would look at everyone personally what they are doing and would take that into account it would be more fair” (Client ID 2, male, 30 years)*

*“If you could adjust the challenge on your own activities I would do more with the app” (Client ID 3, female, 31 years)*

*“I think that for people at Poort, sporting outside DWP should also be rewarded” (Client ID 4, male, 29 years)*

*“It would be more motivating when I can do activities that are important for myself” (Client ID 6, male, 27 years)*

*“It would of course be very good if all clients can score points on the activities that are important for themselves” (Client ID 5, male, 44 years)*

### **6.1.3. Conclusion**

So in conclusion, when the clients were asked for their preferences after these four weeks, all clients were more in favor of the non-unified design. The reason for this was that the clients were more satisfied with the non-unified design because they had the feeling that this was more fair in terms of opportunity to win something, a higher degree of clarity and a higher degree of autonomy to choose in which activities you want to excel on and on which one not. However, something interesting happened when we were continuing with the interview. The clients were indicating that the overall leaderboard had some positive points. These were the possibility to see your overall score and the possibility to challenge each other while both being able to perform different type of activities which is increasing the perceived relatedness of the users (Rock, 2009). So, they were appreciating the possibility to excel at one activity while still being able to see how they are performing in comparison to the other team members. This opinion was shared among 5 of the 7 clients. The other two clients were in favor of the small leaderboards and it did not matter to them whether there was a big leaderboard or not.

*“It is nice for the challenges when you have one overall winner, but you should be able to see who was the best for each separate challenge as well” (Client ID 5, male, 44 years)*

*“You can choose an overall winner, but you should not forget the ‘small’ winners that are performing one specific activity very well” (Client ID 3, female, 31 years)*

*“With the big leaderboard, you can challenge your friends while still being able to perform different activities. But I still prefer to have the small leaderboards as well” (Client ID 4, male, 29 years)*

*“I think that people benefit more from the small challenges with a big summarizing challenge on top” (Client ID 7, male, 25 years)*

This possibility was also perceived as very valuable by employees of DWP. This would make it possible to start a big GameBus challenge per ward. Therefore, the decision was made to continue with the small leaderboards for each activity with one overarching leaderboard that adds up all separate challenges. The overarching leaderboard is thus positively affecting the feeling of relatedness of the clients while the small leaderboards are of importance for the feeling of competence. This combination of leaderboards would lead to the case where the clients have the possibility to choose for which leaderboard they are competing which in turn would increase their level of autonomy as well. So, when these findings are translated to the first decision moment in Figure 7 it was concluded that:

*Continue with the sub-challenges accompanied with one overarching challenge.  
Improve this design in the next phase with the use of personalization.*

## **6.2. Personalized design**

The last three weeks of the pilot were focusing on the personalization of the GameBus challenge in terms of activities. The challenge was personalized by giving the clients the possibility to enroll in the challenges they were interested in. So instead of enrolling in all challenges, the participants personally decided in which challenges they were participating and in which challenges they were not participating. In addition to this, all participants were asked for a personally valuable activity that was not awarded with points in GameBus until now. This personalized design was thus focusing on

personalization in terms of activities. The experiences of the clients of this design are described below. All clients indicated that they value the personalized design more than the non-personalized design. However, they indicated that each participant should have an equal amount of activities such that one person could not have an excess of activities in the challenges while others could perform only a number of activities.

### **6.2.1. Motivation**

The participants indicated that their motivation was higher for the personalized challenge. The main reason for this was that they had the feeling that the design slightly better matched with their personal needs in comparison to the non-personalized design. When GameBus is providing the possibility to motivate the clients to perform the activities that are important for their treatment program, the clients perceive GameBus as more useful and motivating. This finding is in line with the fact that a person is motivated to achieve feelings of accomplishment and self-fulfillment (Maslow, 1954). This feeling of being able to choose the activities that matter to themselves increased their level of autonomy. In addition to that, they have the feeling that this personalized challenge is a better representation of their level of activity inside DWP. This increased their feeling of accomplishment which is positively affecting their level of perceived competence. A few supporting claims that were retrieved from the interview analysis are as follows:

*“It is more challenging and motivating when you can perform the activities in GameBus that are really important for you to do” (Client ID 2, male, 30 years)*

*“Since every client is different in terms of which activities they perform, I find it very valuable when you can choose the activities that are important for your own treatment” (Client ID 3, female, 31 years)*

*“It is very motivating to receive points for the activities that I am personally performing inside DWP” (Client ID 4, male, 29 years)*

*“It is more motivating when you have a challenge based on your own activities” (Client ID 6, male, 27 years)*

*“It is more motivating when you can perform personal activities, this is what you eventually want to achieve inside DWP” (Client ID 5, male, 44 years)*

### **6.2.2. Fairness and fun**

Since this design was using a more personalized perspective by taking personal activities into account that were not measured in the first four weeks, the participants indicated that they perceived this challenge as more fair. They indicated that every client is very different in terms of activities that they perform and the number of activities they perform. So, when each client is able to perform the activities that are important for themselves, they perceive the challenge as more fair. This finding is closely related to the fact that fairness can be achieved by equal opportunity to win. Since the first four weeks didn't give the participants the opportunity to decide personally which activities were implemented, this both decreased the perceived fairness and fun of the participants. This is in line with the earlier mentioned findings of Gilbert (2013) and Rock (2009). A few statements that were given that support this conclusion are as follows:

*“Now that everybody can get points for activities that matter to themselves, I think that it is more fair” (Client ID 4, male, 29 years)*

*“It is more fun when you can score points for the activities that are important for yourself, since it will increase the chance of winning” (Client ID 3, female, 31 years)*



*“I really liked it that you could choose an activity that was important for yourself, this made the challenge more fair” (Client ID 6, male, 27 years)*

*“I think it is more fun when you can personally choose which activities you want to perform in GameBus” (Client ID 7, male, 25 years)*

### 6.2.3. Non-personalization versus personalization

The pilot consisted of three separate challenge designs that were tested with the participants. The first two challenge designs were non-personalized while the last design was personalized in terms of activities. This section will describe the user perception differences between the non-personalized challenges and the personalized challenges. In other words, it is comparing the user experiences of the first four weeks with the last three weeks of the pilot. This will be done with the quantitative scales that were assessed during the intermediate- and post-test questionnaires.

#### Fun

The fun dimension of GameBus was assessed by using the ‘interest/enjoyment’ scale. Firstly, a paired-samples t-test was performed to compare the perceived fun in the non-personalized and personalized conditions (since the number of participants are very low, these results should be interpreted with great caution). The results from this analysis are shown in Table 42 and Table 43 in Appendix O. The paired-samples t-test showed that there was a significant increase in the scores for the non-personalized (M=3.476, SD=.390) and the personalized (M=4.000, SD=.688) conditions (p=.012). The interpretation of the results will increase in value when they are combined with the MCID. The calculated MCID for the fun questions is shown in Table 8.

Table 8. MCID calculation for the Fun questionnaire.

| Construct          | ‘No change’ (n = 1) | ‘A little change’ (n = 3) | MCID |
|--------------------|---------------------|---------------------------|------|
| Interest/enjoyment | .29                 | .62                       | .33  |

From Table 8 it can be concluded that the minimal importance difference for fun was equal to .33. This implied that when the clients scored the personalized design at least .33 points higher than the non-personalized design, it was an important difference for them. Figure 16 shows this comparison with the MCID of the intervention of the point estimate and the 95% CI surrounding it. The figure should be interpreted as follows. The dotted line shows the minimal increase that the clients perceived as an important change. The dense sphere shows the mean change that was accomplished by the intervention accompanied with its 95% CI that is visualized with the line together with the open spheres.

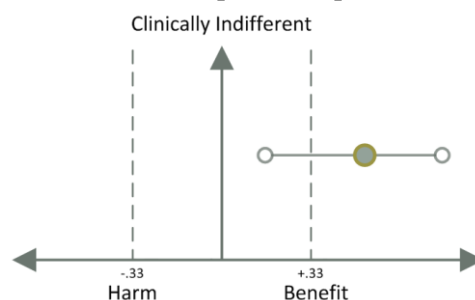


Figure 16. CI 95% and MCID for 'fun'.

Figure 16 shows that the MCID for fun is in the 95% CI. There is an increase in perceived fun between the intermediate- and post-test and this increase is greater than the calculated MCID. However, since the MCID is in the 95% CI one can conclude that the effect of personalization on the perceived fun of the participants is probably clinically important (see Figure 10).

The proposed hypothesis regarding the effect of personalization on the perceived fun was as follows: *Adapting GameBus to the personal needs has a positive effect on the perceived fun of the challenges*. On the basis of the findings, this hypothesis could be **accepted**. This difference could be categorized as probable clinically important which implied that **there is a probable importance difference** in perceived fun when a more personalized design was used.

### Fairness

The fairness dimension of GameBus was assessed by using the distributive justice scale from (Colquitt & Rodell, 2011) that was described in 3.4.4.2. The results from the paired-samples t-test are shown in Table 42 and Table 43 in Appendix O. The paired-samples t-test showed that there was no significant difference in the scores for the non-personalized (M=3.250, SD=.975) and the personalized (M=4.000, SD=.129) conditions (p=.072). The calculated MCID for the fairness questions is shown in Table 9 and the combination of the MCID and CI 95% of the fairness measure is given in Figure 17.

Table 9. MCID calculation for the Fairness questionnaire.

| Construct            | 'No change' (n = 2) | 'A little change' (n = 2) | MCID |
|----------------------|---------------------|---------------------------|------|
| Distributive justice | .38                 | .75                       | .38  |

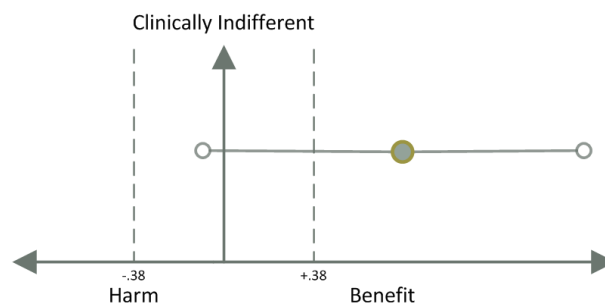


Figure 17. CI 95% and MCID for 'fairness'.

From Figure 17 it can be concluded that the mean change is greater than the MCID for fun. However, the mean change is not significant and therefore, the line crosses the Y-axis.

The hypothesis was formulated as follows: *Adapting GameBus to the personal needs has a positive effect on the perceived fairness of the challenges*. Since the difference between the two measures was not statistically significant, this hypothesis was **rejected**. However, because of the MCID measure it could be concluded that **there is a probable importance difference** in perceived fairness when a more personalized design is implemented.

### 6.2.4. Conclusion

Based on the findings that are discussed in 6.2.1, 6.2.2 and 6.2.3 it can be concluded that the clients value the personalized design more in terms of motivation, fun and fairness. This increase in user experience is caused by a higher fit to personal needs, more equality in terms of opportunity to win and a higher perceived level of fun. However, the findings also show that there are still possible future improvements in the personalized design. One of these improvements is adapting the assigned points to personal characteristics. Most of the clients indicated rightly that they thought the challenges could be more fair if the degree of effort a client has to put into going to or performing an activity would be

taken into account. Research showed that rewarding effort instead of activity can be of great value to increase the motivation of people (Steers et al., 2004) and perceived fairness (Janssen, 2000). Therefore, adapting scoring systems to personal characteristics was a very interesting topic for future investigation.

In conclusion, the above described results provided a lot of information regarding the experiences of the users. The template that was set-up in section 5.3.2 provides a way of structuring these results and to support the decisions that were made during the pilot study. The filled in template is given in Table 10. The scores of each type of design were based on the number of references of the coding scheme of the interviews that is shown in Appendix P. The frequency that each requirement was mentioned during a specific evaluation of a design was used for scoring each design.

*Table 10. Decision table for best design.*

| <b>Requirement and importance weight</b> | <b>Non-unified and non-personalized</b> | <b>Unified and non-personalized</b> | <b>Mixed and personalized</b> |
|--|---|-------------------------------------|-------------------------------|
| <b>Relatedness (2)</b>                   | 1                                       | 1                                   | 1                             |
| <b>Autonomy (2)</b>                      | 1                                       | 1                                   | 2                             |
| <b>Competence (2)</b>                    | 2                                       | 1                                   | 3                             |
| <b>Treatment Awareness (2)</b>           | 1                                       | 1                                   | 1                             |
| <b>Motivation (3)</b>                    | 2                                       | 1                                   | 3                             |
| <b>Fun (3)</b>                           | 2                                       | 1                                   | 3                             |
| <b>Fairness (3)</b>                      | 2                                       | 1                                   | 3                             |
| <b>Overview (1)</b>                      | 2                                       | 1                                   | 2                             |
| <b>Total score</b>                       | <b>30</b>                               | <b>18</b>                           | <b>43</b>                     |

Table 10 shows that on the basis of the requirements the best score was achieved when the personalized challenge was applied. This is also in line with the other above-mentioned results and supported the decision to continue with the personalized design.

*Continue with the personalized design.  
Improve this design in the next phase with the use of personalized scoring systems.*

### **6.3. GameBus experience in general**

In addition to the findings that were specifically focusing on the different design decisions in GameBus, the interviews and questionnaires also provided meaningful insights in GameBus usage in general. These findings can be divided in motivational effects, treatment awareness, fun and the activity levels of the clients. These findings will be described in the remainder of the chapter.

*“GameBus is a very useful and interesting app” (Client ID 1, male, 35 years)*

*“I really like the app, but I think that it should be adapted even more to the personal needs than how it currently is designed (Client ID 3, female, 31 years)*

*“I really like to participate in the GameBus challenges” (Client ID 5, male, 44 years)*

*“It is very useful to keep track of everything that you are doing which gives you an overview” (Client ID 7, male, 25 years)*

*“GameBus can really motivate you to perform the activities that you do not like to do” (Client ID 4, male, 29 years)*

### 6.3.1. Motivation

Motivation was evaluated with the use of the Self-Determination Theory (Vlachopoulos et al., 2010) and the Intrinsic Motivation and Identified Regulation from the SIMS (Guay et al., 2000). It was assumed that using GameBus would increase the feeling of relatedness, autonomy and competence of the users. In addition to that, the usage of GameBus should also have a direct effect on the intrinsic motivation and identified self-regulation of the clients to comply to treatment.

Firstly, a paired-samples t-test was performed to compare the perceived feelings of relatedness, autonomy and competence of the users before and after the pilot. The results of this test are shown in Table 38 and Table 39 in Appendix O. The paired samples t-test showed that there was a significant increase in the perceived autonomy for the pre-test (M=3.083, SD=.785) and post-test (M=3.583, SD=.584) conditions (p=.025) and a significant increase in perceived competence for the pre-test (M=3.500, SD=.592) and post-test (M=4.083, SD=.465) conditions (p=.009). However, the perceived relatedness showed a small insignificant decrease during the pilot. The values were equal to M=3.833 (SD=.547) during the pre-test and M=3.667 (SD=.730) with p=.203. An explanation for this unexpected effect might be that the pilot participants were not from one department and they were not really connected to each other. In addition to that, some participants changed from department during the pilot. This led to the situation that they were not seeing each other on a regular daily basis or they were not seeing each other at all. This could have harmed the feeling of connection between the participants during the pilot which could have a detrimental effect on the feelings of relatedness (Rock, 2009).

Afterwards, the intrinsic motivation and identified regulation was assessed with a paired-samples t-test. The results of these analysis are shown in Table 40 and Table 41 in Appendix X. The statistics showed that there was a significant increase in the perceived intrinsic motivation for the pre-test (M=2.958, SD=.485) and post-test (M=3.583, SD=.585) conditions (p=.007) and a significant increase in identified regulation (M=3.625, SD=.467) and post-test (M=3.912, SD=.465) conditions (p=.013).

After the analysis of the SDT and motivation in terms of statistical differences, the MCID was calculated for these constructs as well. First, the SDT will be described which will be continued by discussing the MCID for motivation. The MCID values of the SDT are shown in Table 11.

*Table 11. MCID calculation for the Self-Determination Theory questionnaire.*

| <b>Construct</b> | <b>'No change' (n = 2)</b> | <b>'A little change' (n = 3)</b> | <b>MCID</b> |
|------------------|----------------------------|----------------------------------|-------------|
| Relatedness      | -.09                       | -.16                             | -.07        |
| Autonomy         | .13                        | .58                              | .45         |
| Competence       | .38                        | .58                              | .20         |

For both the 'autonomy' and 'competence' constructs, the MCID was compared to the 95% confidence intervals that were retrieved from the paired-sample t-tests. These intervals can be derived from Table 39. The reason for excluding the relatedness measure was because no clear results were retrieved from the quantitative analyses and because of the non-normality assumption of the mean difference. This normality test already indicated that the t-test might not be valid and therefore, the decision was made to review this construct only qualitatively.

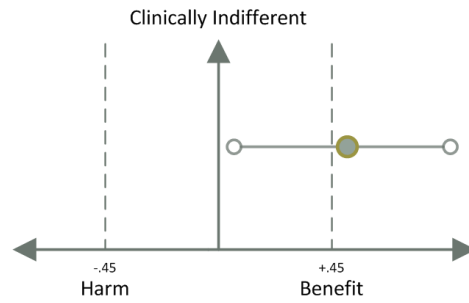


Figure 18. CI 95% and MCID for 'autonomy'.

Figure 18 shows that the MCID for autonomy is in the 95% CI. There is an increase in perceived autonomy between the pre- and post-test and this increase is greater than the calculated MCID. However, since the MCID is in the 95% CI one could say that the effect of GameBus on the perceived autonomy of the participants is probable. So, the change in perceived autonomy when using GameBus is probably clinically important. The same was done for the assessment of the effect of GameBus on the perceived competence. This evaluation is shown in Figure 19.

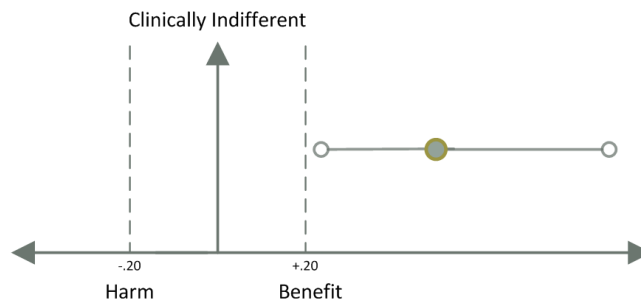


Figure 19. CI 95% and MCID for 'competence'.

From Figure 19 it can be concluded that there is a definite clinical importance difference because the mean change is greater than the calculated MCID and the 95% CI lies completely above the MCID estimate. This implies that the clients perceived a definite clinically important change in competence when they were using GameBus.

The next step was to calculate the MCID for the motivational constructs. These calculations are shown in Table 12 and will be followed by comparing the MCID with the 95% CI of the intrinsic motivation and identified regulation scales.

Table 12. MCID calculations for the Motivation questionnaire.

| Construct             | 'No change' (n = 2) | 'A little change' (n = 3) | MCID |
|-----------------------|---------------------|---------------------------|------|
| Intrinsic motivation  | .25                 | .75                       | .50  |
| Identified regulation | .25                 | .38                       | .13  |

When the MCID's for intrinsic motivation and identified regulation were compared to the confidence intervals that are given in Table 41, the following two figures were created.

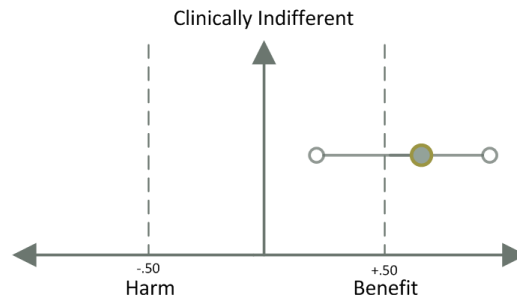


Figure 20. CI 95% and MCID for 'intrinsic motivation'.

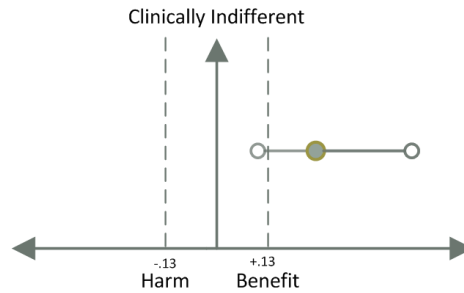


Figure 21. CI 95% and MCID for 'identified regulation'.

From Figure 20 and Figure 21 it can be concluded that for both intrinsic motivation and identified regulation there was a probable clinical importance difference between the two measure moments. This implied that using GameBus achieved a probable clinical importance difference in intrinsic motivation and identified regulation regarding treatment compliance of the clients during the pilot period. Based on these findings, the proposed hypotheses could be either rejected or accepted. An overview of these results is given in table Table 13.

Table 13. Overview tested hypotheses regarding SDT and motivation.

| Hypothesis                 | Increase/decrease | Significant   | MCID effect | Hypothesis |
|----------------------------|-------------------|---------------|-------------|------------|
| GB → Relatedness           | Decrease          | Insignificant | N.A.        | Rejected   |
| GB → Autonomy              | Increase          | Significant   | Probable    | Accepted   |
| GB → Competence            | Increase          | Significant   | Definite    | Accepted   |
| GB → Intrinsic Motivation  | Increase          | Significant   | Probable    | Accepted   |
| GB → Identified regulation | Increase          | Significant   | Probable    | Accepted   |

### 6.3.2. Treatment Awareness

After the 7-week pilot period, the clients were asked whether they were more aware of their treatment. This meant that it was investigated whether GameBus made them more aware of their treatment activities and that by performing these activities, they are actively working on their treatment. 5 out of the 6 clients indicated that using GameBus increased their treatment awareness. The main reason for this was that they said that before Gamebus they were just doing the activities but they weren't really aware of the benefit in terms of their treatment. In addition to that, having an overview of how many blocks they visited and how well they were doing in comparison to the other clients also provided meaningful insights for the clients and gave them a good feeling. Non-compliance to treatment is, among others, a result of lack of understanding the importance of the treatment activities (treatment awareness) and forgetfulness (Jin et al., 2008). Since GameBus can deliver the clients an overview of which activities are important for their treatment and can guide them through their treatment activities,

it is a very valuable in decreasing the non-compliance rate of clients. Some statements that were given by the pilot participants that provided evidence for the increase in treatment awareness were:

*“I suddenly realized that I often cancel important appointments or that I just not showed up. Now I see that that is a shame for the progression in my treatment”*(Client ID 4, male, 29 years)

*“It provides a good insight in the activities that I perform on a weekly basis”* (Client ID 1, male, 35 years)

*“GameBus has brought me a more structuralized day program since I am more aware of the activities that I perform”* (Client ID 5, male, 44 years)

*“GameBus can really give you advantages personally because it provides important information”* (Client ID 6, male, 27 years)

*“It is nice to have an overview of what you are doing”* (Client ID 3, female, 31 years)

Therefore, it could be assumed that GameBus had a positive influence on the treatment awareness of the clients which is in line with the proposed hypothesis ‘**GameBus usage has a positive effect on the treatment awareness of the users**’. However, this increase was not statistically tested.

### 6.3.3. Fun

Besides the interest and enjoyment scale, the participants were asked the simple question: “Would you like to use GameBus again?”. This question is derived from the Fun Toolkit and is based on the knowledge that people like to do things again, when they judge it as fun. Although this scale is normally used for children, it is a very simple and useful tool to score experiences of fun. The following results were obtained during the pilot which show that 5 out of the 6 clients would like to use GameBus again in the future while only 1 client indicates that he maybe wants to continue using GameBus in the future. The main reason for the client that indicated that he maybe wanted to continue is because he thinks that the scoring of the activities could be more fair and could be better adjusted to the personal goals (Client ID 2, male, 30 years).

Table 14. Again-again matrix GameBus.

|  | Yes   | Maybe | No |
|--|-------|-------|----|
| <b>Would you like to continue using GameBus?</b> | ✓✓✓✓✓ | ✓     |    |

As stated in section 3.4.4.2, it is very useful to combine assessment scales with supporting open questions. These open questions were used to get an insight regarding what clients recognize as a fun game. During the interviews, some aspects were mentioned that the clients perceived as important to make GameBus fun. Some important aspects that are increasing the fun dimension is the usage of rewards, the feeling of mastery, positive feedback, the possibility to variate to personal needs, being treated fairly and being in a team with people that are close to you. GameBus provides these dimensions that the clients perceive as fun, especially when a more personalized design would be applied. Some statements that were given during the interview and that are indicating fun were:

*“In a playful way, being occupied with your treatment activities”* (Client ID 7, male, 25 years)

*“I like being rewarded for the activities that I perform”* (Client ID 4, male, 29 years)

*“I like to win challenges, so it was very fun for me to participate in GameBus”* (Client ID 5, male, 44 years)

#### 6.3.4. Increase in activities

An interesting evaluation was to look at the degree of activity of the pilot participants a few weeks before the pilot started and during the pilot. For each client, the number of attended sport, therapy, training and education blocks in the 7 weeks before the pilot and the 7 weeks during the pilot was reviewed. The numbers showed that each week was very different from other weeks. This could be explained by the fact that the programs of clients are subjected to a lot of factors that the clients not always can influence by themselves. However, when the means were compared from the two time frames, the following results were obtained.

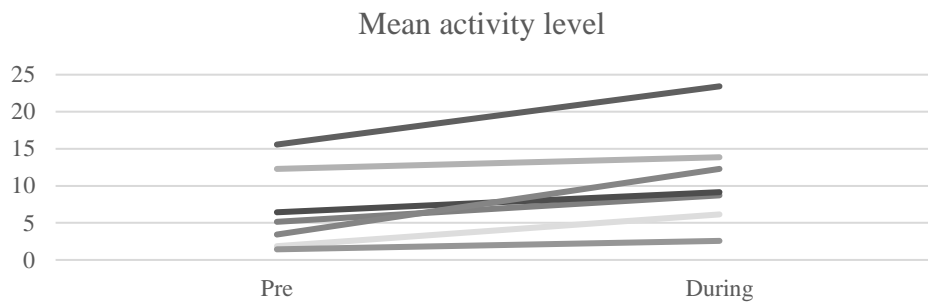


Figure 22. Mean activity level per pilot participant before and during pilot.

From Figure 22 it could be concluded that there was a slight increase in the mean activity levels of the clients. The increase in activity levels can be explained by two causes. First of all, some clients were attracting new activities during the pilot and secondly, the 'no-show' frequency decreased slightly. Since the motivation of the clients to comply to treatment was increasing during the pilot and clients were eager at winning challenges, it could be assumed that at least a proportion of this increase could be assigned to the usage of GameBus.

#### 6.4. Conclusion and discussion

From the statistically significant results and the MCID scores most of the hypothesis could be accepted. The only variable that showed no improvement during the usage of GameBus was an increase in the feeling of relatedness. However, the results showed very promising results regarding the other variables. It could be concluded that GameBus have a positive effect on the clients to comply to their treatment in terms of autonomy, competence, intrinsic motivation and identified regulation. In addition to that, the personalized GameBus challenge showed a significant increase in the perceived fun of the clients. Additionally, there was an increase in perceived fairness but this difference was not statistically significant. Using GameBus also showed a positive effect on the treatment awareness of the clients. These results showed great potential for providing a solution for the problem DWP is facing regarding a low motivation of the clients to comply to treatment. Implementing GameBus as a motivating app could accelerate and enhance the treatment of the clients.

The quantitative claims had to be interpreted with great caution. The small sample size and relatively short implementation period made it hard to draw firm conclusions about the effects of GameBus usage on the output variables. In addition to that, the clients that were used in this pilot were not completely chosen randomly. This means that the experimental design was quasi-experimental which might have harmed the internal validity of this study (Cook, 2015). Future research should thus focus on a larger and a more diverse sample size such that the results would be more generalizable.

However, the results of this study did increase in value because of the usage of interviews which showed largely the same results as the quantitative evaluations. The clients indicated that they value the usage of GameBus as a motivating and monitoring app in their treatment. So, to get back to the central research question of this phase that was formulated as: *Which GameBus design achieves the highest*



*motivation to comply to treatment of clients in DWP and satisfies the dimension of fairness and fun?* we can conclude that the **personalized design** that used both a global leaderboard and smaller sub-leaderboards achieved the highest motivation to comply to treatment and achieves the highest perceptions of fairness and fun. This result was achieved by using an iterative testing procedure that was derived from the theory of persuasive profiling. It adapted GameBus on the basis of the responses of the pilot participants accompanied with small questionnaires and personal data.

However, the pilot resulted in future improvements that could be applied to make GameBus even more applicable and effective for motivating the clients to comply to their treatment. One of these improvements is the third design that was evaluated with both clients and employees. A complete overview of the improvements will be given in the next chapter.

## **PART 4**

### **FUTURE STATE DESCRIPTION**

This part describes the second research objective of this master thesis which is about the future state of GameBus inside DWP. Based on the findings that were retrieved from the implementation phase, different improvement points for the future design were retrieved. It will start with describing the preferences regarding 'smart scoring systems' and will continue with the description of a decision support tool that can guide employees in the decision-making process for personalized challenge design. Since it was found that GameBus has the potential to motivate the clients of DWP to adhere to their treatment, it can assist the employees in putting the usage of the HKT-app into practice by using the decision support tool.

## 7. Evaluation

This chapter is focusing on answering the research question: *How should GameBus be designed such that it is applicable in practice by DWP?* To answer this research question, two sub-questions were formulated that guided this question. The first one discusses the possible improvement points in GameBus that were retrieved from the findings of the pilot. In addition to that an evaluation of the last design decision that was focusing on adding smart scoring systems to the GameBus challenge is discussed. This evaluation was done with both clients and employees.

### 7.1. Improvements to GameBus

During the pilot period, both clients and employees were giving valuable information regarding possible improvement points that could be implemented in GameBus which would enhance the applicability of GameBus inside DWP.

Based on the interviews that were held with the clients, some improvement points were developed. These improvement points can be divided in different categories. These categories are shown in Figure 23. The more often a certain improvement point was mentioned, the bigger the slice is in the diagram. Some statements that were given during the interviews were:

*“Provide support and recognition from the employees and choose your own activities” (Client ID 4, male, 29 years)*

*“I would like to continue using GameBus, but there should be more support from the employees” (Client ID 5, male, 44 years)*

*“I think you should make teams per ward” (Client ID 7, male, 25 years)*

*“The activities should be more adapted to a person” (Client ID 6, male, 27 years)*

*“Make teams that are roughly performing the same activities” (Client ID 3, female, 31 years)*

*“Make different type of challenges for clients that are diagnosed with psychosis and clients that are diagnosed with personality disorders” (Client ID 2, male, 30 years)*

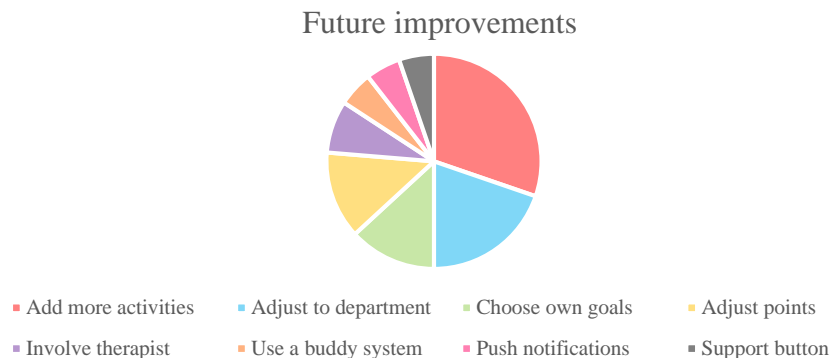


Figure 23. Future improvements for GameBus inside DWP.

From the interviews, it could be concluded that the top 5 improvement points were: add more activities, adjust the challenge to the department of a client, choose your own goals, adjust the points that are awarded for the activities and involve the therapist in the challenges. The other 3 improvement points were more focusing on the appearance and functionalities inside GameBus. By personalizing the challenges even more and by the development of the decision support tool, the top 5 improvement points will be implemented in the future.

## 7.2. Evaluation of smart scoring systems

The different types of scoring systems that were discussed in 5.2.3 were evaluated with the use of interviews and small questionnaires. The results that were retrieved from the evaluation of the smart scoring systems with both clients and employees are described below.

### 7.2.1. Evaluation by clients

The clients that participated in the pilot were asked about their preferences regarding the different scoring systems. All of them created a top 3 out of the proposed scoring systems and they were asked whether they were missing a type of scoring system.

In table 8, the preferred scoring systems for each client are given. Some indicated that they did not have a very clear number 1, 2 and 3 position. Therefore, the table should not be interpreted in the way that preference 1 is the best scoring system for a client (client ID 1 is excluded because this client left the pilot group before this evaluation moment).

*Table 15. Client preferences for scoring systems.*

| Client ID | Preference 1    | Preference 2    | Preference 3         |
|-----------|-----------------|-----------------|----------------------|
| 2         | Weekly limit    | Linear          | Adjusted leaderboard |
| 3         | Goal completion | Increasing      | HKT-adjustment       |
| 4         | Linear          | Weekly limit    | Goal completion      |
| 5         | Goal completion | HKT-adjustment  | Linear               |
| 6         | Linear          | Goal completion | Increasing           |
| 7         | Increasing      | Goal completion | Linear               |

From Table 15 it was concluded that there are a few proposed scoring systems missing. The scorings systems that were not mentioned by the clients are: decreasing, daily completion, daily limit and baseline improvement. The clients judged these systems as either demotivating or not applicable in this environment because of the unstable environment. When the preferred scoring systems were ranked on most preferred to least preferred the following list was created:

1. a) Linear and b) Goal completion
2. Increasing
3. a) Weekly limit and b) HKT adjustment
4. Adjusted leaderboards

The two systems that were mentioned by almost all clients were the linear system and the goal completion. They appreciate the linear system because of the simplicity. The goal completion is a useful system to be able to set goals and to be triggered to achieve these goals. Afterwards, the increasing system was valued as meaningful because it is motivating the clients to perform activities that they do not like to perform. In most cases, they start very motivated with, for example their therapies, however after a few times they are having a difficult time to keep going to these meetings.

### 7.2.2. Evaluation by employees

The employees were asked to evaluate the scoring systems by filling in a short questionnaire accompanied with a description of the different personas that were found in the pilot. The persona creation and evaluation of the scoring systems are described in the next sections.

### 7.2.2.1. *Development of personas*

For evaluating the scoring systems with the employees, personas were created based on the information that was collected during the pilot. Personas represent a cluster of users who have the same characteristics. They are used to create reliable and realistic representations of the users and can help in evaluating new features ideas (Pruitt & Grudin, 2013). It is an important step in design since it will lead to a better match to the needs and wants of the users (Hamari & Tuunanen, 2014). In order to create personas that are an accurate representation of the users it is important to conduct user research, condense the research and make them realistic.

There are four overarching categories that can be used to segment users. These four categories are: geographics, demographics, psychographics and behavioral characteristics (Hamari & Tuunanen, 2014). The most promising categories for creating personas in this study are psychographics and behavioral characteristics. Interesting and useful variables in these categories that were retrieved from observations during the pilot, interview sessions, surveys and employee interviews and that could be used for developing these personas were as follows:

- Degree of competitiveness (desire to win) and motivation (desire to play)
- Degree of effort in performing the treatment activities (difficulties on social, cognitive or physical level)
- Department
- Stage inside DWP
- Care path (diagnosis) of client
- Whether the client has a full daily program
- Number of enrolled challenges in GameBus

When the clients of the pilot were scored on each of these variables a table was created that gives a color code to different values of these variables. These results are shown in Table 47 in Appendix Q. Based on this table, different personas could be created. Since different characteristics were considered, it is important to know which features are most important in defining personas. In addition to that, the features should be easy to understand for the employees when they are deciding to which persona a client belongs. Therefore, a ranking in the characteristics was made. In addition to that, an evaluation was done regarding possible connections between the characteristics. Before continuing with discussing the assumptions, an explanation has to be given to substantiate assumption 6 and 7. Research has shown that treatment compliance is associated with an open and self-revealing attitude (Gudjonsson & Main, 2008). Psychotic clients are more closed since they experience a higher degree of social anxiety and have difficulties with connecting with others (Rössler et al., 2011). Therefore, it can be assumed that they have to put more effort in complying to their treatment since they must overcome more difficulties. The following assumptions were created that reduced the number of important characteristics.

*Assumption 1: When a client is residing in Woensel, they are either in the hospitalization or treatment phase*

*Assumption 2: When a client is residing in Poort, they are either in both the treatment and resocialization phase or only in the resocialization phase*

*Assumption 3: When a client is residing in Woensel with care path personality, they have a full to medium filled daily program which is also connected to the number of enrolled challenges in GameBus*

*Assumption 4: When a client is residing in Woensel with care path psychosis, they have a medium to low filled daily program which is also connected to the number of enrolled challenges in GameBus*

*Assumption 5: When a client is residing in Poort, they have a medium to low filled daily program which is also connected to the number of enrolled challenges in GameBus. This is independent from the diagnosed care path of that client*

*Assumption 6: Clients with care path psychosis generally have to put more effort in performing their activities than clients with care path personality*

*Assumption 7: When a client is residing in Poort, they generally have to put more effort in performing their activities than the same type of client in Woensel*

Based on these hypotheses and characteristics, the decision tree in Figure 24 was developed which led to the division of the pilot participants in certain groups. Some of the features were left out of the decision tree, because no clear differences between the personas could be found and because the proposed important features already classify the personas in a decent and meaningful manner.

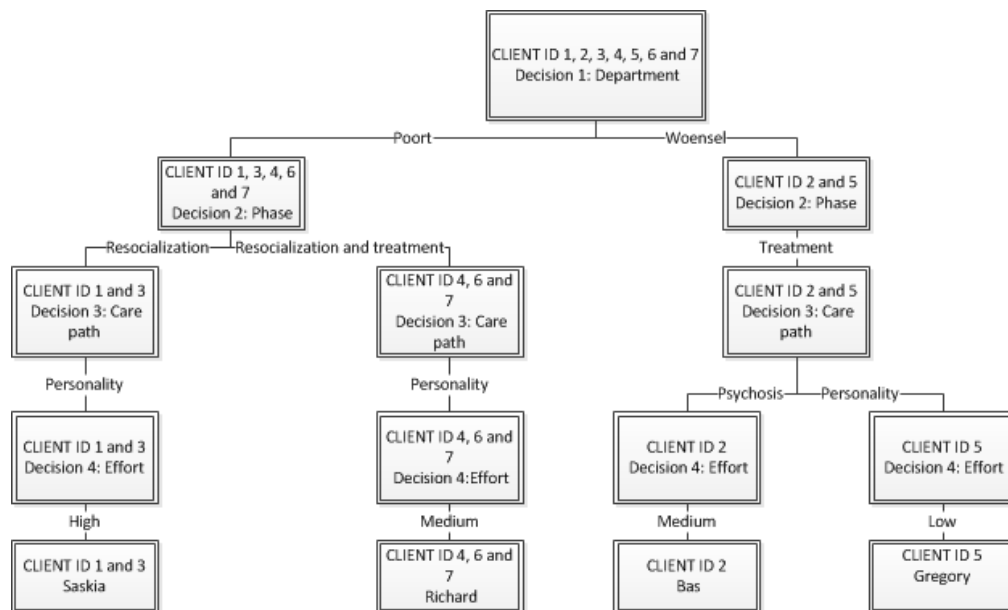


Figure 24. Decision tree personas creation.

Based on this decision tree, 4 significantly different personas were created that were covering all the pilot participants. A name and a short description of this persona were created that give an understanding in which department this persona is residing, which care path this persona is in and which kind of player this persona was during the GameBus challenges. The first persona is client ID 5 and is called ‘Gregory’, the second persona is called ‘Richard’ in which Client ID 4, 6 and 7 could be categorized, the third persona is client ID 2 and is called ‘Bas’. Lastly, persona 4 is called ‘Saskia’ among which client ID 1 and 3 belong. These personas accompanied with their characteristics are shown in Figure 40 in Appendix R. These personas were used for evaluating the scoring systems with the employees. Using these personas increased the understanding of the employees regarding which type of players are possible inside DWP. The 4 personas already cover a substantial portion of possible GameBus users inside DWP. However, these personas do not cover all possible GameBus users. These missing personas could be retrieved from the proposed hypotheses and will be discussed in the next section.

### 7.2.2.2. Missing personas

Based on the hypotheses that were formulated in 7.2.2.1 the missing personas could be added to the decision tree in Figure 24. This would lead to a complete overview of the different personas that are possible inside DWP. The extended decision tree is shown on the next page in Figure 25.

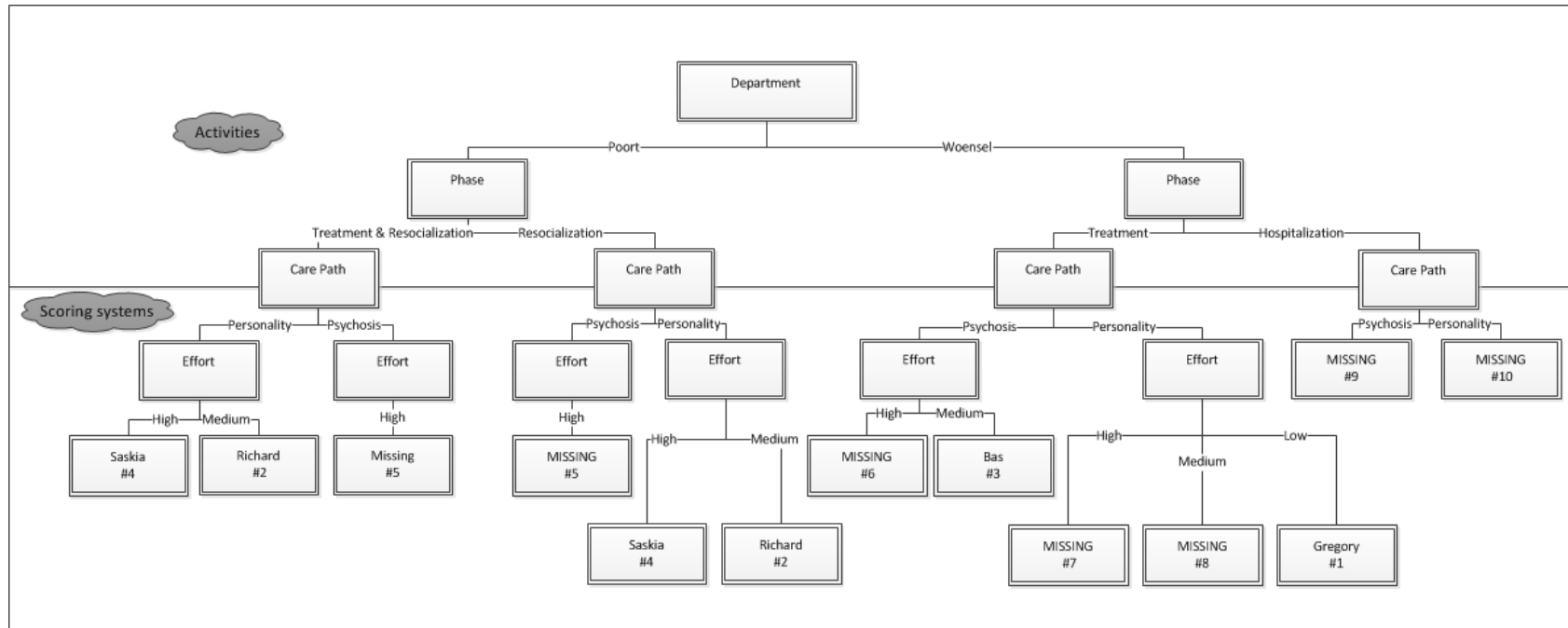


Figure 25. Extended decision tree personas creation.

Figure 25 shows that there are a total of 10 possible personas inside DWP. The first part of the decision tree is used for the decision in terms of activities while the second part of the decision tree is used for the scoring system that needs to be used. The decision was made to finally segment the personas with the use of the term ‘effort’. This decision was made with the knowledge that an imbalance between efforts and rewards has a negative influence on a person’s emotions and motivation (Siegrist, 2009). Having a good balance between efforts and rewards are fundamental aspects for clients inside DWP to be motivated to comply to their treatment as it increases their perceived levels of fairness and fun. For the hospitalization phase, the decision was made to only include one persona for each care path. The reason for this is that still little is known about that user and therefore the decision was made to make this challenge the same in terms of scoring systems and default values for each player in a certain care path. These personas formed the basis for the decision support tool that is described in chapter 8.

### 7.2.2.3. Evaluation of scoring systems

The evaluation of the scoring systems with the employees was done by using a short questionnaire that was aiming at answering four types of questions. The first one was whether the employees perceived the particular scoring system as valuable. Afterwards, the current benefits and drawbacks of the system were asked. This was followed by investigating whether they perceive it as a valuable scoring tool for each phase, activity and/or client. The personas were given to the employees such that they had an understanding about the possible clients inside DWP and that they could get an insight in what a certain scoring system is doing with the scores of each type of user. The questionnaire that was used for this assessment is shown in Appendix S.

Firstly, the employees had the possibility to score the systems on a scale from 1 (absolutely not applicable) to 5 (very applicable). The results are shown in Table 16.

Table 16. Employee preferences for scoring systems.

| Employee           | Linear    | Increasing | Decreasing | Baseline  | Limit     | Goal completion | HKT       | Adjusted leaderboards |
|--------------------|-----------|------------|------------|-----------|-----------|-----------------|-----------|-----------------------|
| 1                  | 4         | 5          | 1          | 1         | 2         | 5               | 5         | 1                     |
| 2                  | 4         | 4          | 1          | 3         | 4         | 4               | 5         | 1                     |
| 3                  | 4         | 4          | 2          | 4         | 1         | 5               | 5         | 1                     |
| 4                  | 4         | 4          | 2          | 2         | 5         | 4               | 5         | 2                     |
| 5                  | 3         | 3          | 2          | 4         | 3         | 5               | 3         | 2                     |
| 6                  | 4         | 4          | 1          | 3         | 4         | 5               | 5         | 1                     |
| <b>Total score</b> | <b>23</b> | <b>24</b>  | <b>9</b>   | <b>17</b> | <b>19</b> | <b>28</b>       | <b>28</b> | <b>8</b>              |

Table 16 shows that the employees largely agreed regarding applicable scoring systems. Especially the linear, increasing, goal completion and HKT systems were scored as very useful. From the interviews it was concluded that there were a number of criteria that the employees were setting for the scoring systems, these were:

1. The scoring systems should be understandable
2. The scoring system should be in line with the importance of a certain activity
3. The scoring system should be in line with the effort a client puts in a certain activity

These criteria are related to the possible personas and should be taken into consideration when deciding the specific default values for a specific scoring system. After scoring each of the systems, the employees were asked what the benefits and drawbacks of a particular system are. These evaluations are summarized in Table 48 in Appendix T. A short discussion of these results is given in the next section and the remaining results of the questionnaire are described in chapter 8.

### 7.3. Discussion results

Based on Table 15, Table 16 and Table 48 it was decided to continue with the following scoring systems: Linear, Increasing, Weekly limit, Goal completion and HKT-based scoring. These results could be supported by available literature as well. First of all, it was not a big surprise that the decreasing, baseline improvement and adjusted leaderboard scoring systems were scored very low. This can be mainly explained by the fact that these scoring systems would ‘punish’ the people that are performing well. This is in contradiction with the general belief that people get the rewards and punishments they deserve. When the clients would have the feeling that there is distributive unjust in the point assignment process this would have a negative effect on the perceived fairness, fun and the motivation to comply to treatment (Ball et al., 1994).



The positive valuation of the linear and increasing scoring system could also be explained by the fact that people want to get the rewards and punishments that they deserve. People expect that when they are performing well they would be rewarded for this (Ball et al., 1994). The increasing system is especially of great value for activities that are hard to persist in. The increasing system would stimulate the clients to continue performing the activities that are hard to comply with since it is known that longer duration of treatment is related to a higher non-compliance rate (Jin et al., 2008). The goal completion scoring system could be of great value because of the earlier mentioned Goal-Setting Theory of Locke and Latham (1994). This theory states that when a person sets a goal accompanied with a clear structure that directs action towards that goal, a person will be more motivated in achieving this goal. It was mentioned by the employees that it would be valuable to make a personal challenge in which the client would be able to see how far he or she is in achieving the set goal. The weekly limit scoring system could be of great value for especially the activities that do not necessarily need to be performed more and more. Lastly, the HKT scoring system would be very useful because it exactly touches upon the problems that DWP is facing and because it can adapt to the personal needs.

#### 7.4. Conclusion and discussion

In conclusion, the research question that guided this chapter could be answered. From 7.1 it could be concluded that the clients perceive it very valuable when the activities and points could be adjusted to the personal needs. In addition to that, they indicated that the employees should be involved in the challenges. With respect to the smart scoring systems, the clients and employees largely agreed about their preferences in scoring systems.

When GameBus would be applied in practice, these scoring systems should be adjusted to the personal needs. In order to be able to make these personalized challenges in terms of activities and scoring systems, the employees should be able to make a conscious choice. Therefore, the decision was made to make a prototype of a decision support tool that guides an employee through the decision-making process regarding personalized challenge design. This tool provides a solution for the difficulties that employees encounter when they are trying to put the HKT-app into practice. It will increase the alignment with the personal needs and it will increase the involvement of the employee in the challenges by making them the challenge designer and by giving them the possibility to monitor the client throughout their treatment. A decision support tool can be applied in a diverse range of organizations for a wide range of decisions. They can be used in different application domains, methods and types of assistance and can range from spreadsheets to sophisticated modeling systems (Pick, 2008). Since this tool will assist employees through a relatively simple decision-making process and they indicated that simplicity is a pre, the decision was made to build the tool with the use of an Excel spreadsheet. For the design of this tool, a few steps had to be taken. These steps are derived from the prototyping model which is a methodology in system development (CMS, 2008). The process that is used in the development of the decision support tool is shown in Figure 26. Each box that is colored dark grey was completed once. These steps will be discussed in the next chapter.

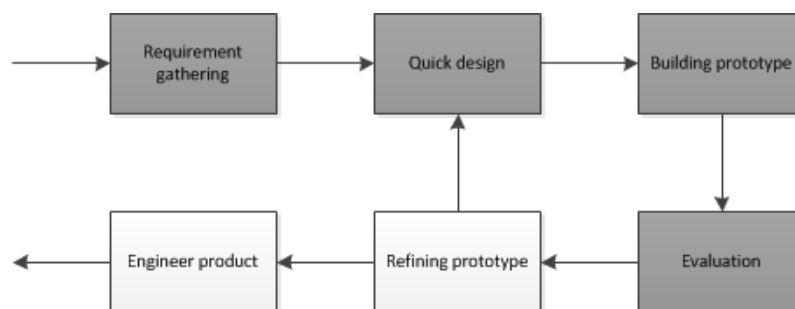


Figure 26. Development process decision support tool.

## 8. Decision support tool

This chapter is answering the research question: *How can the information from the implementation and evaluation phase be used to develop a decision support tool that helps an employee with personalized GameBus challenge development?* Based on the findings during the implementation and evaluation phase, a tool was developed that can guide an employee through the development of a GameBus challenge. These challenges are a translation of the derived HKT-scores to a practical level. The development of this tool was done with the use of the steps that are shown in Figure 26. The findings showed that there is an evidently need for personalized challenge design because there is a very diverse client population inside DWP. This tool gives the possibility to develop a challenge for a specific client based on their personal characteristics. In other words, it is supporting the employee to create a personalized challenge based on the client's available data. This will solve the difficulties that both employees and clients are facing regarding applying the HKT-app on a daily level. The first step of the tool is to help an employee decide upon which activities should be included in the challenge. The second part of the tool will support the decision about how these activities should be scored. During the development of this tool, different employees were asked to give input regarding their preferences in possible activities, scoring systems and the design of the tool. Besides that, the different possible scoring systems were retrieved from the earlier interviews with the employees in the evaluation phase. The final input source was the feedback that was obtained during the implementation phase from the pilot participants.

### 8.1. Construction of decision support tool

The decision tool will be used to support an employee inside DWP in deciding which activities and which scoring systems should be used in a personalized challenge in GameBus. A decision support system consists of three components, namely: data management, model management and user interface management (Ariav & Ginzberg, 1985). The data management component consists of three different types of data, namely: personal data, activity type data and activity specific data. These types of data fall in the categories 'patient-specific data and information' and 'knowledge based information' from the general division of health care information categories (Wager et al., 2009). This choice of datatypes was made because it would be easy to adjust the possible values of each data type to other departments in de GGzE or in the healthcare sector in general. In each data type, different input data is necessary and different output data will be generated. The output will be generated in the model management component. This component will make two decisions: which activities should this client perform and which type of scoring system accompanied with the amount of points will be awarded for this activity. This in turn will deliver the output in the user interface component. So in conclusion, the decision tool will be build up as is shown in Figure 27 on the next page.

### 8.2. Requirements and constraints

The requirements that are needed to develop this decision tool can be divided into required input and output information (data management) and the user requirements that were set to the tool (model and user interface management) (CMS, 2008). As already mentioned above, the users prefer an understandable system that could easily guide them through the decision-making process. They expect that the system would show the recommended and possible activities and scoring systems for a specific client accompanied with the right values for each scoring system. To be able to achieve this, some input and output requirements needed to be set and the information needed to be collected. This is part of the data management component and will be described in the next section.

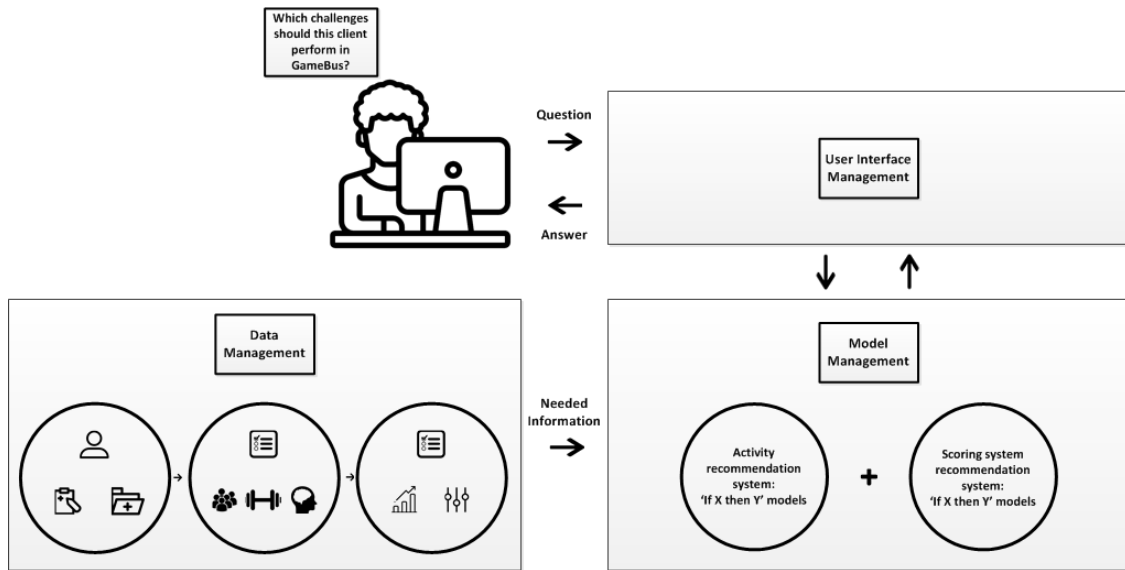


Figure 27. Structure decision support tool.

### 8.3. Data management

The input and output requirements that are used in the data management component were retrieved from interviews with domain experts and from available documentation. Table 17 shows the different input and output variables that are needed to execute the tool. The input data was largely the same as the variables that were used in the decision tree of the development of the possible personas inside DWP. A small adaptation has been made to these variables to make it easier to generalize and apply it to other departments or institutions.

Table 17. Input and output decision support tool.

|                                       | Level                                    | Specific variables                         |
|---------------------------------------|--|--|
| <b>Input data</b>                     | Personal                                 | Diagnosis                                  |
|                                       |  | Department                                 |
|                                       |  | Stage                                      |
|                                       | Activity type                            | HKT-scores                                 |
|                                       |  | Possible activities                        |
|                                       | Activity specific                        | Recommended activities                     |
|                                       | <b>Output data</b>                       | Personal                                   |
| Selected activities                   |  |  |
| Possible scoring systems per activity |  |  |
| Activity type                         |  | Scoring default values                     |
|                                       |  | Data from personal and activity type level |
| Activity specific                     |  | Recommended activities                     |
|                                       |  | Selected activities                        |
| Activity specific                     | Recommended scoring systems per activity |  |
|                                       | Scoring adjusted values                  |  |
|                                       | Performance levels per activity          |  |

As can be seen from the table, the model starts with the general diagnosis of the client. Afterwards, institution specific data is used such as department and stage of the client. Lastly, possible taxation tools can be added to increase the knowledge that is needed to make useful and meaningful recommendations. When this data is implemented, the recommended activities will be given. This recommendation in turn will be used to specify whether the client has difficulties with performing these

activity types on a social, cognitive or physical level. This classification of activities is used because of the fact that this is a very powerful way in categorizing health activities (McCallum, 2012) and because of the link to the three GameBus pillars. In addition to that, it gives an estimation about whether the client has to put more effort in doing these types of activities. The information that is collected up to this point will in turn be used to give recommendations about the scoring systems per activity, their scoring values and performance adjustment levels. Since the personal level data is discussed during the creation of the personas and the scoring systems are discussed in the evaluation phase these will not be discussed in detail. However, the possible activities need further explanation.

### **8.3.1. Determination of activities**

For each stage inside DWP, different activities are relevant for a client. Therefore, the input activities can be specified per stage. There are four stages, namely: hospitalization, treatment, resocialization and treatment and resocialization. The information that was needed to make a decision regarding the important activities was retrieved from internal documentation and from conversations with domain experts from each different possible stage. Each stage is shortly described below.

#### **Hospitalization**

The hospitalization phase is the first phase a client goes through when they are hospitalized in DWP. This phase takes 8 weeks and the goal of this phase is to diagnose the patient correctly and to get the client acquainted with the possible activities inside DWP. The introduction to the possible activities is based on a weekly schedule that is shown in Table 49 and Table 50 in Appendix U. During this phase, GameBus can be of great value to motivate the client to attend the scheduled blocks during the 8-week program. The type and amount of activities are the same for each client. In addition to the mandatory activities, the clients also have the opportunity to participate in sports and labor. So in total, the following activities should be included in the ‘hospitalization challenge’: Training, Therapy, EHealth and education, Occupational therapy, Sport and Labor.

#### **Treatment**

The activities in the treatment phase are largely the same as the activities in the challenge during the pilot. However, the decision was made to divide the activities slightly different than in the pilot design. Most of the time in DWP, the clients are working on their treatment by performing activities that are improving their risk taxation by performing the following activities: Sport, Therapy, Training, Labor, Occupational therapy and EHealth and education.

#### **Resocialization**

The resocialization phase is the final phase a client goes through when they are hospitalized in DWP. This phase is focusing on preparing the client to return to society. There are three categories of activities that are important during this phase. Each of these categories can be split up in smaller activities. The following activities are important: General daily activities (‘Algemeen Dagelijkse Levensverrichtingen’ (ADL)) that can be specified in: Get up on time, Clean room, Cook a healthy meal, Arrange your finances; Special daily activities (‘Bijzondere Dagelijkse Levensverrichtingen’ (BDL)) which are: Sport, Labor, Education and Occupational therapy and finally, Work on future by performing the following activities: Maintain a positive network and Work on your future steps.

#### **Treatment and resocialization**

When a client is in both treatment and resocialization he or she is still working on treatment related activities but is also focusing on the resocialization stage inside DWP. When this is the case, both activities from treatment and resocialization can be added to the challenges.

## 8.4. Model management

The next step in the decision support tool is to develop the models. As can be seen in Figure 27, there are two underlying decision models, namely: activity recommendation and scoring system recommendation. The models are built with so called ‘if-then rules’ that work with forward reasoning. This means that on the basis of a true antecedent, a particular consequent will be triggered and this process will continue until the desired solution is delivered (McLeod & Schell, 1998). These rules will be described for both the activity and scoring system recommendation system in the next sections.

### 8.4.1. Activity recommendation

The activity recommendation depends on several variables that are shown in Table 17. First of all, the department and stage of a client are of importance. Secondly, the HKT-scores of a client are of importance, provided that they are known of that client. The HKT-scores are known from the moment that a client is in the treatment phase. So, when a client is in the hospitalization phase, no information regarding their HKT-scores is available. Therefore, the following decision rule can be used for the activity recommendation system during the hospitalization phase:

*If Department = Woensel AND Client stage = Hospitalization then Recommended activities = Training, Therapy, eHealth and education and Occupational therapy*

The reason for this recommendation is that these 4 activities are mandatory for each client in the hospitalization phase. The employee has the possibility to personally add either sport or labor to the challenges of this client.

The other decision rules are a little bit more complicated. These rules depend on both the department, stage and HKT-scores of a client. In order to be able to make this decision, a weighting must be given that indicates the importance of a specific activity for a specific risk factor. The values of the weightings are achieved with the help of domain experts. For each activity, a weighting was given of 0; 0.5 or 1 in which 0 indicates ‘not important for this risk factor’, 0.5 indicates ‘a little bit important’ and 1 indicates ‘very important’. These weightings are shown in Table 51 in Appendix V. Then, each activity has a total importance value that ranges from 0 to 14 in which 0 would mean not important for each of the risk factors to 14 which means very important for all risk factors. Of course, none of the activities have a total score of 0 since each activity can improve at least one risk factor. The method for calculating the importance weight of an activity was as follows: for each risk factor that has a score  $\geq 3$  the tool will look up how important that activity is for that risk factor which can be either 0, 0.5 or 1. Then the total importance of an activity can be calculated by counting the importance scores for each risk factor  $\geq 3$  and subdivide this sum by the total importance of that activity. So for each activity, the weighted importance can be calculated as follows:

$$\begin{aligned} \text{Weighted importance score activity } X (\text{WIS}_x) \\ = \frac{\text{Sum}(\text{For each risk factor } Y \geq 3: \text{Importance score of } X \text{ for } Y)}{\text{Total importance activity } X} \end{aligned}$$

Based on these weightings, the following rules could be developed for the activity recommendation system:

*If Department = Woensel AND Client stage = Treatment then Recommended activities = ‘Top 5 weighted activities from treatment phase’*

If Department = Poort AND Client stage = Resocialization then Recommended activities  
= 'Top 5 weighted activities from resocialization phase'  
If Department = Poort AND Client stage  
= Treatment & Resocialization then Recommended activities  
= 'Top 5 weighted activities from treatment and resocialization phases'

Then, the activities are selected with the 5 highest importance scores. These will be recommended to the employee. One additional constraint that was set to the tool was that there is a maximum of 2 recommended activities from the category 'ADL'. This was done such that not too much emphasis was put on these types of activities. After this recommendation, the employee has the possibility to adjust the activities if they prefer another activity over one or more of the recommended activities. The employees cannot choose more than 5 activities to make the challenge clear and manageable. The next step is to give the recommended scoring systems. This is described in the next section.

#### 8.4.2. Scoring systems recommendation

The actual scoring systems that could be applied are based on the interviews that were conducted with the clients and the employees. Out of the 10 proposed scoring systems, a total of 4 scoring systems were seen as useful inside DWP with the additional HKT-scoring system to calculate the actual scores per scoring system. So, it was decided to use the HKT-scores as a second dimension in the scoring systems. The HKT together with a number of other variables will be used to determine the specific scores or weights for the other four scoring systems and is not so much a scoring system in itself. Since the clients that are in the hospitalization phase did not yet had the risk taxation, this HKT adjustment is only applicable to the clients that are in either the treatment and/or resocialization phase. These scoring systems then in turn can be used for specific phases, types of activities and personas. The possible options are derived from the questionnaires that were filled in by the employees. An overview is given in Table 18.

Table 18. Overview scoring systems for activities and personas.

| Scoring system                                  | Applicable for phase          | Applicable for activity   | Applicable for persona            |
|---|-------------------------------|---|-----------------------------------|
| <b>Linear</b>                                   | All                           | All   | All                               |
| <b>Increasing</b>                               | All                           | Activities that are treatment focused, activities which take a lot of effort    | #1, #2, #4, #7, #8 and #10        |
|   |                               | All   | #3, #5, #6 and #9                 |
| <b>Maximum weekly score per activity</b>        | Treatment and resocialization | Activities that are less treatment focused, activities which take little effort | #1, #2, #4, #7 and #8 and #9      |
| <b>Completion of total week program</b>         | Treatment and resocialization | All   | #1, #2, #3, #4, #5, #6, #7 and #8 |
| <b>Importance factor based on HKT-app score</b> | Treatment and resocialization | Activities that are treatment focused   | #1, #2, #3, #4, #5, #6, #7 and #8 |

As can be concluded from Table 18, the most important differences can be retrieved from whether an activity is applicable to the hospitalization phase or to the treatment and/or resocialization

phase and whether the client is diagnosed with care path psychosis or personality which can be seen in the personas column. For the recommended default values, a value was chosen with the following criteria: 1) Time spent on activity, 2) Amount of effort spent on activity (difficulties with activity), 3) General importance of activity for either treatment or resocialization and 4) Care path of client. For the linear scoring system, the value that is given are the points that an activity would receive each time it is performed. For the increasing scoring system, the value that is given is the increase in points the activity should be given each time it is performed. The maximum value represents the maximum score for that activity on a weekly basis. And finally, the bonus scoring system shows the bonus that should be rewarded to the activity after the client has achieved the desired goal. This bonus is a percentage of the total points that are scored up to that point. When this was translated to the real default values, the following values were obtained:

**Linear default values.** The linear default value is either equal to 5, 6, 8 or 10. 5 points are assigned to the ADL activities, 6 points are assigned to activities that are semi-treatment focused, less important for progress inside DWP or resocialization and take less time. The activities that are semi-treatment focused but are still important for progress inside DWP or resocialization get a value of 8. Finally, the treatment focused activities have a linear default value of 10.

**Increasing default values.** There are two default values: +.75 is given to clients with care path psychosis and activities that are treatment focused while +.5 is given to clients with care path personality or to clients with care path psychosis for performing activities that are semi-treatment focused.

**Maximum default values.** There are 4 default values for the maximum scores. This can be either 4, 16, 20 or 40. These values are indicating the maximum amount that an activity should be performed on a monthly basis. The employees were indicating that performing these activities more than those maximum values would probably be non-value added in the recovery of a client.

**Bonus default values.** The default bonus values are either equal to 15% or 20%. A bonus of 20% is given to activities that are treatment focused or to activities that are semi-treatment focused, but that are still important for progress inside DWP or resocialization. 15% is given to activities that are semi-treatment focused, less important for progress inside DWP or resocialization or it takes less time to perform in comparison to activities that score value 20%

A more extensive explanation of these values accompanied with an overview per activity that shows which systems can be applied, which system is recommended and which default value is applicable for either clients with psychosis or personality care paths is given in Table 52 and Table 53 in Appendix W. An important remark on the default values is that it is based on the findings of the pilot and feedback of domain experts. However, the correctness of these values should be evaluated during the implementation of the decision support tool in future research.

These default values in turn could be adapted with the use of the HKT-scores and the difficulty levels of the client in terms of social, cognitive and physical activities. Before these adoptions could be made, each of the activities should be categorized as either a social, cognitive or physical activity. This categorization is shown in Table 52 and Table 53 in Appendix W as well. These adaptations are done with the following formulas:

### **Hospitalization**

In the hospitalization phase, the only variable that is used for adapting the scoring systems is the level of difficulty a client experiences when performing either social, cognitive or physical activities.

When a client experiences difficulties for a specific activity type and this activity is selected, a weight of 1 is given to the adaptation score which leads to the following rule:

*For Selected Activity if Adaptation score = 1 then Linear = default + 1 and Increasing = default + .2 else Linear = default and Increasing = default*

### **Treatment and/or resocialization**

In the treatment and/or resocialization phase, the adaptation score is based on both HKT-scores and the level of difficulty in performing a specific activity. It was chosen to give an adaptation score ranging from 0 to 3. These adaptation scores are calculated as follows:

*If Activity type = not difficult and WISx = 0 then Adaptation score = 0*

*If Activity type = not difficult and  $0 < WISx < .5$  OR Activity type = difficult and WISx = 0 then Adaptation score = 1*

*If Activity type = not difficult and  $WISx \geq .5$  OR Activity type = difficult and  $0 < WISx < .5$  then Adaptation score = 2*

*If Activity type = difficult and  $WISx \geq .5$  then Adaptation score = 3*

This adaptation scores in turn can calculate the adapted scoring systems with the following rules:

*For Selected Activity if Adaptation score = 0 then All scoring values = default*

*For Selected Activity if Adaptation score = 1 then Linear = default + 1, Increasing = default + .15, Maximum = default and Goal = default + 5%*

*For Selected Activity if Adaptation score = 2 then Linear = default + 2, Increasing = default + 0.2, Maximum = default and Goal = default + 10%*

*For Selected Activity if Adaptation score = 3 then Linear = default + 3, Increasing = default + 0.25, Maximum = default and Goal = default + 15%*

Now that the adjusted scoring systems are known, the following step in the decision tool is to define and design the user interface management component. This is described in the next section.

### **8.5. User interface management**

The user interface management is the actual decision support tool that can be used by the employees. This master thesis builds a prototype of this decision support tool with the use of Excel. The Excel sheet shows the recommended activities and scoring systems to the employees in a straightforward manner. Before the prototype was built, a quick design was made for a quick evaluation of the tool with a few domain experts. The description of this quick design is given in the next section. Afterwards, the prototype of the decision tool will be discussed.



### 8.5.1. Quick design

A quick design of the decision support tool was made with the use of decision trees. These decision trees included the steps that should be implemented in the decision tool and are shown in Figure 42, Figure 43 and Figure 44 in Appendix X. These decision trees made it possible to evaluate the general purpose of the decision support tool with a number of domain experts. The evaluations showed that the employees agreed with the decision tool and were very enthusiastic about the deployment of these challenges in motivating and monitoring the clients inside DWP. Based on these evaluations, it was decided to build the decision tool as was proposed to the employees. This final decision tool is discussed in the next section.

### 8.5.2. Prototype design of decision support tool

The final decision tool that was developed with the use of all gathered information is shown in Figure 28 on the next page. As can be seen in this figure, the tool consists of 5 steps, namely:

1. Determination of diagnosis, department and phase
2. Calculation of HKT-scores (if applicable)
3. Recommendation and determination of activities
4. Determination of personal 'difficulties' on social, cognitive or physical level
5. Calculation of possible default scoring systems accompanied with the recommended and adjusted scoring systems based on the personal characteristics and HKT-scores

The tool will show for each selected activity which scoring system is recommended, which other systems could be applied and which adjusted values should be given to the activities. Next to these values, the default values are given. When the scoring systems are being clicked, a short explanation of the scoring system will be given. When this is applied to Therapy in Figure 28 it would look as follows:

Table 19. Example scoring systems.

|                     | Linear             | Increasing       | Maximum | Bonus when goal achieved |
|---------------------|--------------------|------------------|---------|--------------------------|
| Training (adjusted) | + 12x <sup>1</sup> | + (12 + .7(x-1)) | N.A.    | + 25% bonus              |
| Training (default)  | + 10x              | + (10 + .5(x-1)) | N.A.    | + 15% bonus              |

<sup>1</sup> x is how many times that activity is performed

## GameBus Challenge Development Tool

Deze tool helpt je te beslissen welke activiteiten tegen welke punten in GameBus moeten worden gezet.

Begin bij stap 1 en 2 en druk op 'Laat aanbevolen activiteiten zien' ga vervolgens verder tot stap 4 en druk vervolgens op 'Bereken scores'. Mocht je weer opnieuw willen beginnen, druk dan op 'Reset formulier' en alles zal weer weggehaald worden.

Stap 1: Geef de diagnose, afdeling en fase van de cliënt aan:

Opnieuw starten?

Reset formulier

Vink aan in welk diagnose deze cliënt heeft:

Psychose

Persoonlijkheid

Vink aan op welke afdeling en in welke fase de cliënt zich bevindt:

Woensel: Opname

Woensel: Behandeling

Poort: Behandeling & resocialisatie

Poort: Resocialisatie

Stap 2: Als beschikbaar, voer de HKT-scores van de cliënt in:

Alleen invullen bij behandeling en/of resocialisatie:

Stap 3: Geef aan welke activiteiten u wilt registreren voor deze cliënt. De aangevinkte activiteiten zijn de aanbevolen activiteiten.

Let op! Voeg maximaal 5 activiteiten toe:

HKT-Waardes:

Beïnvloedbaarheid: 3

Probleeminzicht: 2

Psychose: 1

Verstaving: 4

Impulsiviteit: 4

Anti-sociaal gedrag: 4

Vijandigheid: 3

Sociaal Gedrag: 4

Zelfredzaamheid: 3

Behandelbereidheid: 1

Verantwoordelijkheid: 2

Copingvaardigheden: 3

Afspraken: 2

Arbeidsvaardigheden: 2

Laat aanbevolen activiteiten zien

Opname:

eHealth & Scholing

Training

Therapie

Dagbesteding

Optioneel:

Sport

Arbeid

Behandeling:

Bezoek eHealth

Deelname scholing

Deelname therapie

Deelname training

Deelname dagbesteding

Behandelinhoudelijk gebruik iPad

Minddistrict gebruik

Sport

Arbeid

Resocialisatie:

ADL:

Op tijd opstaan

Kamer schoonmaken

Gezonde maaltijd koken

Financiën regelen

BDL:

Sport

Arbeid

Dagbesteding

Scholing

Toekomst:

Positief netwerk opbouwen

Werk aan vervolgstappen

Stap 4: Geef onderstaande karakteristieken aan van de cliënt:

Minder sterk op:

Sociaal vlak

Cognitief vlak

Fysiek vlak

Geen van allen

Bereken scores

Stap 5: Kies systeem aan de hand van onderstaande aanbevelingen. Klik op het scoresysteem, op aanbevolen, basis scores en uitleg voor meer informatie.

|           | Aanbevolen | Lineair | Stijgend | Maximum | Bonus  | Basis scores | Lineair | Stijgend | Maximum | Bonus |
|-----------|------------|---------|----------|---------|--------|--------------|---------|----------|---------|-------|
| ScholingB | Stijgend   | 9       | 0,65     | 0       | 20%    | 8            | 0,5     | 0        | 15%     |       |
| TrainingB | Bonus      | 12      | 0,7      | 0       | 25%    | 10           | 0,5     | 0        | 15%     |       |
| iPad      | Maximum    | 8       | 0        | 16      | 0%     | 6            | 0       | 16       | 0%      |       |
| MD        | Bonus      | 12      | 0,7      | 0       | 25%    | 10           | 0,5     | 0        | 15%     |       |
| SportB    | Maximum    | 9       | 0        | 16      | 25%    | 6            | 0       | 16       | 10%     |       |
|           |            | Uitleg  | Uitleg   | Uitleg  | Uitleg |              |         |          |         |       |

Figure 28. Prototype GameBus challenge decision support tool.

## 8.6. Testing the decision support tool

The tool was tested by running it 4 times with the personas that were retrieved from the pilot participants. The decision was made to exclude the other 6 personas since no information was available regarding the HKT-scores and difficulties regarding their social, cognitive or physical activities. This led to the results that are shown in Table 54 in Appendix Y. These results show that the recommended activities vary per persona. In addition to that, the recommended scoring systems and the values of the scoring system differ per persona as well. The results show a decent recommendation for the employee regarding recommended activities and scoring system for a specific client. The results were also evaluated with an employee of DWP which indicated that the results are very applicable to each persona. For example, when the decision support tool is inserting the givens of Gregory (client ID 5), the recommended activities, scoring systems and adapted values are as follows:

Table 20. Example of output decision tool for persona 'Gregory'.

| Activities           | Recommended scoring system | Linear | Increasing | Maximum    | Bonus      |
|----------------------|----------------------------|--------|------------|------------|------------|
| <b>Therapy</b>       | Bonus                      | 13     | .75        | N.A.       | <b>30%</b> |
| <b>Training</b>      | Bonus                      | 13     | .75        | N.A.       | <b>30%</b> |
| <b>Usage of iPad</b> | Maximum                    | 9      | N.A.       | <b>16x</b> | N.A.       |
| <b>Minddistrict</b>  | Bonus                      | 13     | .75        | N.A.       | <b>30%</b> |
| <b>Sport</b>         | Maximum                    | 8      | N.A.       | <b>16x</b> | 20%        |

### 8.7. Putting the decision support tool into practice

The next step in the development of the decision support tool is to explain how it would be used in practice. This section gives a short explanation of how the personalized challenges would work and look like when it is applied in DWP. This is explained by given a short description of the set-up of the challenges and the usage of the different types of scoring systems.

#### 8.7.1. Challenges set-up

Each first day of the month, the new challenges will start. The employee will choose which activities will be performed by each client by inserting their HKT-scores and social, cognitive and physical levels. These HKT-scores are based on a conversation between client and employee in which they discuss the scores that both client and employee have given for each risk factor. The reason for this monthly system is because there is a changing client population per ward and because the clients encounter many difficulties and uncertainties during their treatment period. This can cause situations in which clients cannot perform their weekly treatment activities and this in turn could cause demotivation when they are lagging behind on the leaderboards. Therefore, the possibility will be given to clients to have a fresh new start on a monthly basis. After the employee has decided which activities will be performed by each client, a global leaderboard will be created per ward and for each activity, a leaderboard will be created in which the entire client population of DWP can be added. This would mean that there will be a total of 16 global leaderboards, 16 sub-leaderboards since this is the number of different types of activities and possibly a personal leaderboard. The client in turn can only see the global leaderboard of his or her ward and a maximum of 5 sub-leaderboards, depending on the number of activities that a client signs up for during the monthly challenge. Lastly, a personalized challenge could be created when a client is striving for achieving a personal goal. The client will perform this challenge and after one month, when the challenge is finished, the employee and client will review the results and a new challenge will be created based on their shared interests. The next step in putting the personalized challenges into practice is to describe how the different types of scoring systems would be applied.

#### 8.7.2. Scoring systems

After the decision has been made regarding which challenges each client will subscribe for, the next step is to translate the type of scoring system into the challenge. As can be seen in the decision support tool, different types of scoring systems can be used for different types of activities and clients. Therefore, the basic scoring system is the linear scoring system. This scoring system can be adapted by adding the increasing, maximum or goal scoring system. This would mean that for every client, the course of the total points received on a monthly basis can be different. The scoring systems can be inserted in GameBus as follows.

*Linear.* The linear system can be easily added in GameBus since this is the current scoring system of GameBus. However, since there are different values of the linear scoring system possible

clients should be assigned to different roles. Each role represents a different amount of points, so each client should be assigned to the role with the desired amount of points.

*Increasing.* The possibility needs to be added to GameBus in which on top of the linear scoring system the option would be added to choose an increasing factor that can be multiplied by with how many times the activity is performed.

*Maximum.* The maximum scoring system can be added by adding the possibility next to inserting the values of the linear scoring system whether the challenge developer wants to set a maximum limit to these scores. This will be translated to the maximum amount of times a client can score points for the activity.

*Goal completion.* The goal completion can be added broadly the same as the maximum score system. However, instead of asking the maximum amount of times a client can perform an activity, the question should be asked how many times a client should perform an activity to get their bonus score. After this bonus is awarded, the client will continue with getting the linear scoring system if they are doing the activity more times than the stated goal. The progression of a client in terms of achieving his or her goal could in turn be implemented in a personal challenge in which the client has the possibility to see how far they are in achieving their personal goal.

So in conclusion, the process of using the tool in supporting the HKT-app would look as shown in Figure 29.

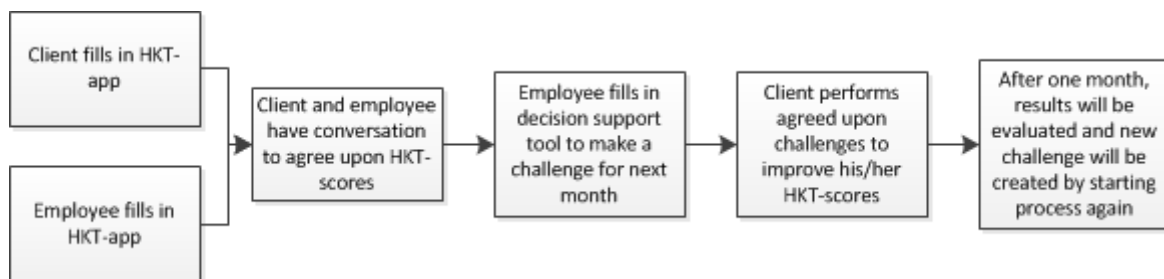


Figure 29. Process implementation decision support tool.

Finally, an evaluation of the decision support tool was done with a few employees. This evaluation was done in order to be able to get insights in their opinions about the tool and about the future improvements of the tool inside DWP. This evaluation is described in the next section.

### 8.8. Evaluation decision support tool

The final tool was evaluated with a few employees. This evaluation was done by evaluating whether the decision support tool was meeting the requirements that were set to the decision support system. In addition to that, some general objectives of a decision support system were evaluated. These objectives were retrieved from McLeod and Schell (1998) which reads as follows: A decision support system should assist in solving semi-structured problems, it should support, not replace, the employee and it should contribute to decision effectiveness, rather than efficiency. In addition to these requirements, the employees were asked to rate the perceived ease of use, perceived usefulness and intention to use with the use of a number of statements. These evaluation points were retrieved from the Technology Acceptance Model of Davis (1985).

First of all, the decision support tool should solve a semi-structured problem. A semi-structured problem can be defined as problems that require both a combination of standard solution procedures and individual judgement (Adam & Humphreys, 2008). This implies that following the decision support tool to reach a decision does not guarantee the most optimal challenge design. Therefore, the employee must make a final judgement about the output of the tool and adjust these recommendations when needed. Since this is possible in the decision support tool, this objective was met. This brings us

immediately by the second objective that states that it should support and not replace the employee. Since the employee needs to make the final decision and needs to implement these challenges in GameBus, the decision support tool will serve as a supporting tool. Therefore, the second objective is met as well. Lastly, because the employees do not have the underlying knowledge about how to successfully develop personalized challenges for increasing the motivation to comply to treatment, the decision tool will help them to make effective decisions.

Secondly, the employees were asked whether they perceived the tool as easy to use and useful. Additionally, they were asked whether they had the intention to use the tool which is also linked to the usage of the GameBus challenges in general. This was done with the usage of 6 statements from the research of Yuxiang and Qinghua (2009). It was chosen to only use a small amount of statements because the evaluation was merely used to get a general understanding of the opinions regarding the decision support tool. Three employees were asked to score the decision support tool, the results are shown in Table 21.

*Table 21. Evaluation decision support tool.*

|  | Completely disagree | Disagree | Neutral | Agree | Completely agree |
|--|---------------------|----------|---------|-------|------------------|
| <b>Ease of use</b>                                     |                     |          |         |       |                  |
| Learning to use the tool is easy for me                |                     |          |         | ✓✓    | ✓                |
| It is easy for me to become skillful at using the tool |                     |          |         | ✓✓✓   |                  |
| <b>Usefulness</b>                                      |                     |          |         |       |                  |
| The tool is very useful in challenge design            |                     |          |         | ✓     | ✓✓               |
| The tool improves the quality of the challenge design  |                     |          |         | ✓     | ✓✓               |
| <b>Intention to use</b>                                |                     |          |         |       |                  |
| It is worth using the tool                             |                     |          |         | ✓✓✓   |                  |
| I will frequently use the tool                         |                     | ✓        | ✓✓      |       |                  |

From Table 21 it can be concluded that the employees perceived the tool as easy to use and very useful for developing personalized challenges in GameBus. The intention to use is quite low, however, this can be explained by the fact that it is still a prototype and there are still a number of practical issues that need to be solved before it can be put into practice. When the ultimate goal and implementation of the decision support tool are explained to the employees, they indicated that their intention to use would increase. They indicate that it is a very useful tool for translating the HKT-scores to a practical level. Therefore, it would be very promising to continue with the development and implementation of the decision support tool since the employees are very enthusiastic about the deployment of GameBus inside DWP as it would increase the motivation of the clients and the usability of the HKT-app.

## 9. Conclusion & discussion

The goal of this research was to investigate which design of GameBus achieved the highest motivation to comply to treatment of clients in DWP. This thesis achieved this goal by implementing different design decisions in GameBus and testing them with a pilot group. Afterwards, the second goal of this master thesis was achieved by the development of a decision support tool that gives an employee inside DWP guidance for putting the HKT-app into practice. This chapter summarizes the answers to the research questions shortly accompanied with recommendations for future research and a reflection on the used methodology.

*Which design of GameBus achieves the highest motivation to comply to treatment of clients in DWP?*

This question was answered with the use of a pilot study among a number of clients inside DWP. The results showed that a **personalized design** achieved the highest motivation to comply to treatment and the highest levels of perceived fairness and fun. This result was achieved by using an iterative testing procedure that was derived from the theory of persuasive profiling. It adapted GameBus on the basis of the responses of the pilot participants accompanied with small questionnaires and personal data. The most important reasons for the findings were that the users experienced a higher fit to personal needs, more equality in terms of opportunity to win and a higher perceived level of fun since the personalized design increased the sense of mastery, choice, fair competition and personal identity. In addition to that, it was found that the client population is very diverse in DWP and therefore, an ‘one fits all’ design is not appropriate inside DWP. The results of this pilot are in line with earlier research regarding gamification and motivation. The personalized design achieved the highest level of competence and autonomy which are important determinants of motivation to comply to treatment (Ryan & Deci, 2000). Additionally, the current development of personalized gamification state that personalizing gamification leads to more positive attitudes towards the technology and positive behavioral change (Böckle et al., 2017). These results were also found in this research. Increasing the motivation to comply to treatment can have major benefits for DWP since non-compliance can have major effects on treatment outcomes and direct clinical consequences. In addition to that, non-compliance would also cause an increase in financial burden since the total treatment period will be longer when a client will not comply to their treatment. This will cause higher treatment costs (Jin et al., 2008). The results from the pilot resulted in a second main research question that will be discussed below.

*How can the findings from the implementation of GameBus be used for the development of a decision support tool for personalized GameBus challenges?*

This question was answered with the development of a prototype of the decision support tool. The results from the evaluation phase showed that there is a need for personalization in both activities and smart scoring systems that can adapt both the type of scoring system and the values of the scores that are used for a specific client. Since it is difficult for an employee to make this decision without any additional help or information, a decision support tool was developed that could guide an employee through this decision-making process. The prototype of this decision tool is shown in Figure 28. Since this decision tool is making decisions on the basis of personal characteristics such as the HKT-scores of a client, it provides the employees and clients a hands-on solution in putting the HKT-app into practice by using a GameBus challenge to improve the risk taxation of the client. The prototype of this tool was evaluated with a number of employees which all indicated that they find it very useful,

understandable and valuable inside DWP. However, the implementation step was not performed in this master thesis since this was left out of scope due to time constraints.

The promising results of both the pilot and the prototype design showed that future research should continue with improving and implementing the tool and GameBus such that it is possible to put the personalized challenges into practice.

### **9.1. Recommendations and future work**

The positive results of this research showed that there are promising future investigations for both DWP, the decision support tool and GameBus. The recommendations and future work suggestions can thus be divided in three areas: DWP, the decision support tool and GameBus. Therefore, the decision was made to split the section in three parts.

#### **9.1.1. De Woenselse Poort**

Since the results of the pilot showed positive results regarding the usage of GameBus as a motivator to increase treatment compliance among the clients, the first recommendation for DWP is to continue with a GameBus pilot on a larger scale. This pilot could give more insights in the usability and effects of GameBus. This new pilot study could use the new personalized challenges set-up that was proposed in this master thesis. This personalization can be enhanced with the usage of the decisions support tool. Therefore, DWP should also focus on the deployment of the decision support tool since the tool is already perceived as a valuable tool for the development of personalized challenges inside DWP. Since the tool was only a prototype design, the real implementation and evaluation of the tool was left out of the scope of this master thesis project. The larger pilot study would test the tool in terms of completeness and correctness. Future research thus could focus on the implementation of the tool with a larger pilot group over a longer period. When this would be done, the results of the personalization of challenges in terms of motivational effects and perceived fairness and fun would be more robust. In addition to that, the smart scoring systems were perceived as valuable, but the real effects of these scoring systems on the outcomes has not been investigated yet. By implementing the decision support tool this will be investigated as well.

#### **9.1.2. Decision support tool**

Future research should also focus on the expansion and extension possibilities of the tool. The tool might be expanded to other departments or health institutions that are also looking for interventions that would increase the motivation to comply to treatment. This research should investigate which input data is of importance for this institution and should change this in the decision support tool. Then, the decision support tool should be evaluated with domain experts and afterwards, the personalized challenges should be implemented in GameBus. These challenges in turn should be tested with a pilot such that more knowledge will be acquired about the usage of GameBus as a motivating and monitoring tool to comply to treatment in other health institutions.

Besides the expansion of the tool to other institutions, future research could also focus on the extension of the decision support tool in terms of important input variables. Currently, the number of input variables is covering the most important personal characteristics, however, there might be more interesting variables to include in the decision process to make the tool even more complete. An example of a possible extension is adding the SDT constructs in the decision process. The feelings of relatedness, competence and autonomy are very important predictors of the intrinsic motivation of a client to comply to their treatment. When the decision support tool could take their current levels of relatedness, competence and autonomy into account and could adapt either the set-up, scores or activities on the basis of that scores, it might even have greater effect on the intrinsic motivation. So for

example, suppose that a client has a very low feeling of competence, it might be a good idea to increase their points even more at the beginning of the challenge since this can have a positive influence on their feeling of mastery. Since this statement is quite suggestive and the real effects are unknown it needs to be investigated in future research.

### **9.1.3. GameBus**

During this master thesis project, different improvement points for GameBus were mentioned by both employees and clients as well. These improvement points can be divided in the improvement of usability of GameBus and the improvement of the current scoring systems.

#### ***9.1.3.1. Improve usability of GameBus***

A number of improvement points were mentioned that would increase the quality of GameBus usage. Firstly, when automatic registration of activities is applied, it is not necessary for the user to see these activities in their activity registration dropdown menu. During the pilot, the participants only needed to register their agenda activity manually. However, when they were opening the app they saw all possible activities which made it unclear and confusing which activities they needed to register personally. It would be easier if these activities were left out of this dropdown menu to decrease the amount of information a user has to process during the usage of GameBus.

Secondly, it was mentioned a few times that it would be valuable, especially in the (mental) healthcare, to be able to make 'personal' challenges. The only persons who need to get subscribed to these challenges are the client and his or her therapist. Therefore, it would be an idea to make two types of challenges: group competition and individual challenges in which the client and therapist can see how far the client is in achieving his or her goal. This personal challenge would especially be valuable for the activities that are goal focused and that uses the bonus scoring system which was discussed in chapter 8.

Thirdly, since the environment in DWP is quite unstable and there is a high probability that clients will leave or enter a department on a regular basis it would be a good idea if GameBus gives the possibility for a new client to 'fly in' a challenge with an average score. The idea behind this recommendation is that when a challenge was just started a week ago and the client would like to participate in it, it is hard for him or her to catch up with the other players. When they have the possibility to get a starting score that is equal to the current average score, they have the possibility to participate and challenge themselves to score high on the leaderboards and do not have to wait until the next month.

#### ***9.1.3.2. Scoring systems***

The first most important recommendation for GameBus is to make it possible to choose different types of scoring systems. Currently, it is not possible to increase points per time an activity is done, to set a limit to the total points on a weekly basis or to get a bonus when a certain goal is achieved. This adaptation should be made in order to be able to test the effects of the smart scoring systems on the user's motivation in GameBus.

Secondly, GameBus starts with a short questionnaire regarding the current activity level of a user in terms of physical, social and cognitive activities. However, these questions are not followed by asking if the user has certain difficulties with performing these types of tasks. When a user for example indicates that he or she rarely sports this could be due to physical limitations. When GameBus knows these limitations, the points that a user gets for performing certain activity types could be adjusted to these limitations. This would make it more fair since the efforts and rewards would be more balanced (Siegrist, 2009).



Thirdly, it would be very valuable when it would be possible to adjust the score of a specific activity with the degree of performance during that activity. Employees inside DWP were indicating that sometimes, clients are present during a block but they are not actively participating. When a certain attribute would be added to the activity that indicates the performance level of that client it can increase the score of that activity when a client is actively participating in that block. This performance attribute could also be of great value in other GameBus challenges.

## **9.2. Reflection on methodology**

The results from the pilot study needed to be treated with great care. The main reason for this was that the pilot period was relatively short and the number of participants was quite low. However, since the results were a combination of quantitative results in terms of significant differences and MCID values and qualitative results it increased in validity. In addition to that, the main goal of the pilot was to investigate the feasibility and best design practices of GameBus as a motivating and monitoring app. The results are quite robust for answering this research question since it could be concluded that a personalized challenge in terms of both activities and scoring systems is needed on the basis of the pilot.

During the project, it was also noticed that it was sometimes hard to find supporting literature or researches. This was mainly caused by the fact that personalized gamification is a relatively new research field and because the research was focusing on a very specific group of users. Therefore, much substantiation of specific choices was based on the knowledge of domain experts. In order to make the research more generalizable, more information should be collected from a larger and more diverse group of clients from other departments or institutions. This would increase the academic validity of this research.

Another limitation of this research was that the environment of a forensic psychiatric hospital is often quite unstable. This resulted in difficulties with finding a large number of pilot participants and with making appointments with the pilot participants. A more stable environment might had resulted in a larger pilot group and more substantiation of the decisions and conclusions of this master thesis. However, showing the feasibility of GameBus in this environment might imply that it would be even more valuable in more stable healthcare institutions. This assumption should of course be researched in future studies.

## **9.3. Final remark**

In conclusion, this master thesis has investigated the role of GameBus inside the forensic psychiatric healthcare sector. It investigated how GameBus could be brought closer to the needs of DWP. This was done by investigating which design practices inside GameBus were most appreciated by the clients and employees of DWP and by further expanding this design set-up by the development of a decision support tool. The at first apparent different goals of both GameBus and DWP could be aligned by using GameBus as a motivator to perform the activities that matter to DWP. The promising results of his study showed that GameBus can be very valuable for different types of organizations and for different types of desired goals. In addition to that, DWP now has a practical tool that can solve the problems that both the employees and clients are facing concerning the usage of the HKT-app on a daily level and with regard to the low motivation to comply to treatment. Therefore, they should continue with the development and improvement of the GameBus challenges in the future such that it can be actually applied in practice by DWP.

## Bibliography

ACSM. (2017). ACSM, AHA Support Federal Physical Activity Guidelines. Retrieved June 6, 2017, from <http://www.acsm.org/about-acsm/media-room/acsm-in-the-news/2011/08/01/acsm-aha-support-federal-physical-activity-guidelines>

Adam, F., & Humphreys, P. (2008). *Encyclopedia of Decision Making and Decision Support Technologies*. Hershey: Information Science Reference.

Alcorn, S., & Turner, W. (2015). *42 rules for engaging members through gamification: unlock the secrets of motivation, community, and fun*. Cupertino, CA: SuperStar Press.

Ariav, G., & Ginzberg, M. J. (1985). DSS design: a systemic view of decision support. *Communications of the ACM*, 28(10), 1045-1052.

Ball, G. A., Trevino, L. K., & Sims, H. P. (1994). Just and unjust punishment: Influences on subordinate performance and citizenship. *Academy of Management Journal*, 37(2), 299-322.

Bert, A. (2017). The personalization of technology in science and health. Retrieved September 20, 2017, from <https://www.elsevier.com/connect/the-personalization-of-technology>

Bijenhof, A. M., Folkertsma, M. A., Kommer, G. J., Slobbe, L. C. J., & Polder, J. J. (2012). Kostenontwikkeling GGZ. *Rijksinstituut voor Volksgezondheid en Milieu*.

Böckle, M., Novak, J., & Bick, M. (2017). TOWARDS ADAPTIVE GAMIFICATION: A SYNTHESIS OF CURRENT DEVELOPMENTS.

Boyle, P. (1996). Cultural and linguistic validation of questionnaires for use in international studies: the nine-item BPH-specific quality-of-life scale. *European urology*, 32, 50-52.

Cameron, J., & Pierce, W. D. (1994). Reinforcement, reward, and intrinsic motivation: A meta-analysis. *Review of Educational research*, 64(3), 363-423.

Chen, J., Mullins, C. D., Novak, P., & Thomas, S. B. (2016). Personalized Strategies to Activate and Empower Patients in Health Care and Reduce Health Disparities. *Health Education & Behavior: The Official Publication of the Society for Public Health Education*, 43(1), 25-34. <http://doi.org/10.1177/1090198115579415>

Colquitt, J. A., & Rodell, J. B. (2011). Justice, trust, and trustworthiness: A longitudinal analysis integrating three theoretical perspectives. *Academy of Management Journal*, 54(6), 1183-1206.

Colquitt, J. A., & Rodell, J. B. (2015). Measuring justice and fairness. *Oxford handbook of justice in the workplace*, 187-202.

Cook, W. (2013). Five reasons you can't ignore gamification. *Chief Learning Officer*, 12(5), 46-55.

- Cook, T. D. (2015). Quasi-experimental design. *Wiley Encyclopedia of Management*.
- Delespaul, P. A. E. G., Milo, M., Schalken, F., Boevink, W., & Os, J. J. (2016). *Goede GGZ!: nieuwe concepten, aangepaste taal en betere organisatie*. Diagnosis uitgevers.
- Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011, May). Gamification. using game-design elements in non-gaming contexts. In *CHI'11 extended abstracts on human factors in computing systems* (pp. 2425-2428). ACM.
- CMS. (2008). Selecting a development approach. *Centers for Medicare & Medicaid Services*, 1-10.
- Cotton, R., Hyatt, J., & Patrick, M. (2013). E-mental health, what's all the fuss about. *Mental Health Network: NHS Confederation*.
- Davis, F. D. (1985). *A technology acceptance model for empirically testing new end-user information systems: Theory and results* (Doctoral dissertation, Massachusetts Institute of Technology).
- DWP. (2017). Onze uitgangspunten. Retrieved March 28, 2017, from <http://www.dewoenselsepoort.nl/over-dwp/organisatie>
- DWP. (2016). *Conceptversie 0.91; Implementatie van E health binnen De Woenselse Poort; hoe leiden we E-Health binnen DWP in goede en veilige banen en minimaliseren we de kans op (digitale) incidenten?* Unpublished internal document. De Woenselse Poort.
- DWP. (2017). *Strategie implementatie e-Health binnen De Woenselse Poort*. Unpublished internal document. De Woenselse Poort.
- Eysenbach, G. (2001). What is eHealth? *Journal of Medical Internet Research*, 3(2), e20. <http://doi.org/10.2196/jmir.3.2.e20>
- Ewijk, C., Horst, A., & Besseling, P. (2013). *Toekomst voor de zorg* (No. 7). Centraal Planbureau (CPB).
- Faber, J., & Fonseca, L. M. (2014). How sample size influences research outcomes. *Dental press journal of orthodontics*, 19(4), 27-29.
- Fleming, T. M., Bavin, L., Stasiak, K., Hermansson-Webb, E., Merry, S. N., Cheek, C., ... & Hetrick, S. (2016). serious Games and Gamification for Mental Health: current status and Promising Directions. *Frontiers in Psychiatry*, 7.
- Gadiyar, A. R. (2014). Gamification 3.0: The power of personalization. *White paper. Cognizant's Global Technology*.
- GameBus. (2017). Mission Statement. Retrieved on March 28, 2017, from <http://www.gamebus.eu/>

GGZNederland. (2013). E-Mental Health in the Netherlands. Retrieved April 6, 2017, from <http://www.ggz nederland.nl/uploads/assets/Factsheet%20e-mental%20health%20in%20the%20Netherlands%20def.pdf>

GGZnieuws.nl. (2014). GGZ-zorg onder druk door bezuinigingen. Retrieved April 6, 2017, from <http://www.ggznieuws.nl/home/ggz-zorg-onder-druk-door-bezuinigingen/>

Ghasemi, A., & Zahediasl, S. (2012). Normality Tests for Statistical Analysis: A Guide for Non-Statisticians. *International Journal of Endocrinology and Metabolism*, 10(2), 486–489.

Grajewski, B. (2015). 10 barriers to healthcare innovation. Retrieved July 17, 2017, from <https://www.theguardian.com/healthcare-network/2015/jan/23/barriers-healthcare-innovation>

Guay, F., Vallerand, R. J., & Blanchard, C. (2000). On the assessment of situational intrinsic and extrinsic motivation: The Situational Motivation Scale (SIMS). *Motivation and emotion*, 24(3), 175-213.

Gudjonsson, G. H., & Main, N. (2008). How are personality disorders related to compliance?. *The Journal of Forensic Psychiatry & Psychology*, 19(2), 180-190.

Inspectie Veiligheid en Justitie (2017). De Woenselse Poort: Incidentonderzoek.

Hamari, J., Koivisto, J., & Sarsa, H. (2014, January). Does gamification work?--a literature review of empirical studies on gamification. In *System Sciences (HICSS), 2014 47th Hawaii International Conference on* (pp. 3025-3034). IEEE.

Hamari, J., & Tuunanen, J. (2014). Player types: A meta-synthesis. *Transactions of the Digital Games Research Association*, 1(2).

Haskell, W. L., Lee, I. M., Pate, R. R., Powell, K. E., Blair, S. N., Franklin, B. A., ... & Bauman, A. (2007). Physical activity and public health. Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation*.

Heydari, A., Ziaee, E. S., & Gazrani, A. (2015). Relationship between Awareness of Disease and Adherence to Therapeutic Regimen among Cardiac Patients. *International Journal of Community Based Nursing and Midwifery*, 3(1), 23–30.

Ilie, G., & Ciocoiu, C. N. (2010). Application of fishbone diagram to determine the risk of an event with multiple causes. *Management Research and Practice*, 2(1), 1-20.

Janssen, O. (2000). Job demands, perceptions of effort-reward fairness and innovative work behaviour. *Journal of Occupational and organizational psychology*, 73(3), 287-302.

JCPMH. (2013). Guidance for commissioners of forensic mental health services.

Jin, J., Sklar, G. E., Oh, V. M. S., & Li, S. C. (2008). Factors affecting therapeutic compliance: A review from the patient's perspective. *Therapeutics and clinical risk management*, 4(1), 269.

Kaptein, M., Markopoulos, P., De Ruyter, B., & Aarts, E. (2015). Personalizing persuasive technologies: Explicit and implicit personalization using persuasion profiles. *International Journal of Human-Computer Studies*, 77, 38-51.

Kim, J. K., & Park, E. S. (2013). Comparative responsiveness and minimal clinically important differences for idiopathic ulnar impaction syndrome. *Clinical Orthopaedics and Related Research*®, 471(5), 1406-1411.

Landorf, K. B., & Radford, J. A. (2008). Minimal important difference: values for the foot health status questionnaire, foot function index and visual analogue scale. *The Foot*, 18(1), 15-19.

Latham, G. P. (2004). The motivation benefits of goal setting. *Academy of Management Executive*, 18(4), 126-129.

Lee, C. I., Chen, I. P., Hsieh, C. M., & Liao, C. N. (2016). Design Aspects of Scoring Systems in Game. *Art and Design Review*, 5(01), 26.

Leon, A. C., Davis, L. L., & Kraemer, H. C. (2011). The role and interpretation of pilot studies in clinical research. *Journal of psychiatric research*, 45(5), 626-629.

Lister, C., West, J. H., Cannon, B., Sax, T., & Brodegard, D. (2014). Just a fad? Gamification in health and fitness apps. *JMIR serious games*, 2(2).

Locke, E., & Latham, G. (1994). Goal-setting theory. *chair in human resources at the State University of New York–Buffalo and was faculty director of the Center for Entrepreneurial Leadership there. Previously he was Research Professor of Management at Georgia State University. He has written over fifty books and over 135 other publications.*, 159.

Malvey, D., & Slovensky, D. J. (2014). *mHealth: transforming healthcare*. Springer.

Man-Son-Hing, M., Laupacis, A., O'Rourke, K., Molnar, F. J., Mahon, J., Chan, K. B. Y., & Wells, G. (2002). Determination of the Clinical Importance of Study Results: A Review. *Journal of General Internal Medicine*, 17(6), 469–476. <http://doi.org/10.1046/j.1525-1497.2002.11111.x>

Marczewski, A. (2015). User Types. In Even Ninja Monkeys Like to Play: *Gamification, Game Thinking and Motivational Design* (1st ed., pp. 65-80). CreateSpace Independent Publishing Platform.

Maslow, A. H. (1954). *Motivation and personality*. New York: Harper and Row.

McCallum, S. (2012). Gamification and serious games for personalized health. *Stud Health Technol Inform*, 177(2012), 85-96.

McLeod, R., & Schell, G. P. (1998). *Management information systems* (Vol. 10). Upper Saddle River, NJ: Prentice Hall.

Minddistrict. (2017). Ehealth platform with personal routes to change. Retrieved June 9, 2017, from <https://www.minddistrict.com/en-gb/ehealth-platform>

- Ministerie van Veiligheid en Justitie. (2016). *Handboek Forensische Zorg*.
- Nicholson, S. (2012). A user-centered theoretical framework for meaningful gamification. *Games+ Learning+ Society*, 8(1), 223-230.
- Nicholson, S. (2015). A recipe for meaningful gamification. In *Gamification in education and business* (pp. 1-20). Springer International Publishing.
- Norušis, M. J. (2006). *SPSS 14.0 guide to data analysis*. Upper Saddle River, NJ: Prentice Hall.
- NVZ. (2014). *Innovating in health care: General hospitals branch report 2014*.
- Palthe, J. (2014). Regulative, normative, and cognitive elements of organizations: Implications for managing change. *Management and organizational studies*, 1(2), 59.
- Pick R. (2008) Benefits of Decision Support Systems. In: *Handbook on Decision Support Systems 1*. International Handbooks Information System. Springer, Berlin, Heidelberg.
- Pruitt, J., & Grudin, J. (2003). Personas: practice and theory. In *Proceedings of the 2003 conference on Designing for user experiences* (pp. 1-15). ACM.
- Rai, S. K., Yazdany, J., Fortin, P. R., & Aviña-Zubieta, J. A. (2015). Approaches for estimating minimal clinically important differences in systemic lupus erythematosus. *Arthritis Research & Therapy*, 17(1), 143. <http://doi.org/10.1186/s13075-015-0658-6>
- Reymen, I.M.M.J. (2014). *Design processes: regulative model cycle; design parameters [PowerPoint slides]*.
- Reymen, I.M.M.J., Hammer, D.K., Kroes, P.A., Van Aken, J.E., Dorst, C.H., Bax, M.F.T., & Basten, T. (2006). A domain-independent descriptive design model and its application to structured reflection on design processes. *Research in engineering design*, 16(4), 147-173.
- Reynolds, L. M., Hodge, P., & Simpson, A. (2017). Serious games for mental health. *Journal of psychiatric and mental health nursing*, 24(4), 183-184.
- Richard, M., Christina, M. F., Deborah, L. S., Rubio, N., & Kennon, M. S. (1997). Intrinsic motivation and exercise compliance. *Int J Sport Psychol*, 28(4), 335-354.
- RIVM. (2013a). RIVM Kosten van Ziekten database 2013. Retrieved July 11, 2017, from [https://kostenvanziektentool.volksgezondheidenzorg.info/tool/nederlands/?ref=kvz\\_v211b1p4r3c0i0t1j0o6y6a-1g0d254s54f0z0w4](https://kostenvanziektentool.volksgezondheidenzorg.info/tool/nederlands/?ref=kvz_v211b1p4r3c0i0t1j0o6y6a-1g0d254s54f0z0w4)
- RIVM. (2013b). RIVM Kosten van Ziekten database 2013. Retrieved July 11, 2017, from [https://kostenvanziektentool.volksgezondheidenzorg.info/tool/nederlands/?ref=kvz\\_v211b1p4r4c7i0t1j0o6y6a-1g0d205s33f0z0w2](https://kostenvanziektentool.volksgezondheidenzorg.info/tool/nederlands/?ref=kvz_v211b1p4r4c7i0t1j0o6y6a-1g0d205s33f0z0w2)

Rössler, W., Hengartner, M. P., Ajdacic-Gross, V., Haker, H., Gamma, A., & Angst, J. (2011). Sub-clinical psychosis symptoms in young adults are risk factors for subsequent common mental disorders. *Schizophrenia research*, *131*(1), 18-23.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist*, *55*(1), 68.

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), 344-360.

Rock, D. (2009). *Your brain at work: strategies for overcoming distraction, regaining focus, and achieving all day long*. New York: Collins Business.

Saunders, M., Lewis, P., & Thornhill, A. (2016). *Research Methods for Business Students* (7th ed.). Pearson Education Limited.

SDT. (2017) Intrinsic Motivation Inventory. Retrieved May 15, 2017, from <http://selfdeterminationtheory.org/intrinsic-motivation-inventory/>

Shahrestani, A., Van Gorp, P., Le Blanc, P., Greidanus, F., de Groot, K., & Leermakers, J. (2017). Unified Health Gamification can significantly improve well-being in corporate environments. In *Engineering in Medicine and Biology Society (EMBC), 2017 39th Annual International Conference of the IEEE* (pp. 4507-4511). IEEE.

Siegrist, J. (2009). Unfair exchange and health: Social bases of stress-related diseases. *Social Theory & Health*, *7*(4), 305-317.

Spreen, M., Brand, E., Ter Horst, P., & Bogaerts, S. (2014). Handleiding en Methodologische Verantwoording HKT-R, Historisch, Klinische en Toekomstige-Revisie.

Steers, R. M., Mowday, R. T., & Shapiro, D. L. (2004). Introduction to special topic forum: The future of work motivation theory. *The Academy of Management Review*, *29*(3), 379-387.

Sterne, J. A. C., & Smith, G. D. (2001). Sifting the evidence—what’s wrong with significance tests? *BMJ: British Medical Journal*, *322*(7280), 226–231.

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach’s alpha. *International Journal of Medical Education*, *2*, 53–55. <http://doi.org/10.5116/ijme.4dfb.8dfd>

Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(1), 78.

Teng, K. (2012, May). What Is Personalized Healthcare? Retrieved March 28, 2017, from <https://health.clevelandclinic.org/2012/05/what-is-personalized-healthcare/>

Thabane, L., Ma, J., Chu, R., Cheng, J., Ismaila, A., Rios, L. P., ... Goldsmith, C. H. (2010). A tutorial on pilot studies: the what, why and how. *BMC Medical Research Methodology*, 10, 1. <http://doi.org/10.1186/1471-2288-10-1>

TMF. (2017). The Top 15 Examples of Gamification in Healthcare. Retrieved on October 4, 2017, from <http://medicalfuturist.com/top-examples-of-gamification-in-healthcare/>

Trimbos. (2017). Langdurige GGZ: Interventies en erkenning. Retrieved October 7, 2017, from <https://www.trimbos.nl/themas/langdurige-ggz-erkenning-interventies>

Turner-Stokes, L., Paul, S., & Williams, H. (2006). Efficiency of specialist rehabilitation in reducing dependency and costs of continuing care for adults with complex acquired brain injuries. *Journal of Neurology, Neurosurgery, and Psychiatry*, 77(5), 634–639. <http://doi.org/10.1136/jnnp.2005.073411>

USA (United Spinal Association). (2015) The importance of rehabilitation. Retrieved March 22, 2017, from <http://www.spinalcord.org/resource-center/askus/index.php?pg=kb.page&id=368>

Van Aken, J. E., Berends, H., & Van der Bij, H. (2010). *Problem-solving in organizations: a methodological handbook for business students*. Cambridge, UK: Cambridge University Press.

Van der Horst, A., & ter Rele, H. (2013). De prijs van gelijke zorg. *CPB Policy Brief*.

Van Strien, P. (1997). Towards a Methodology of Psychological Practice: The Regulative Cycle. *Theory & Psychology*, 7: 683-700.

Ventrice, T. (2011). Gamification: Framing the Discussion. Retrieved on June 23, 2017, from [https://www.gamasutra.com/view/feature/6530/gamification\\_framing\\_the\\_.php](https://www.gamasutra.com/view/feature/6530/gamification_framing_the_.php)

Vlachopoulos, S. P., Ntoumanis, N., & Smith, A. L. (2010). The basic psychological needs in exercise scale: Translation and evidence for cross-cultural validity. *international Journal of sport and exercise psychology*, 8(4), 394-412.

Wager, K. A., Glaser, J. P., & Lee, F. W. (2009). *Health care information systems: a practical approach for health care management*. San Francisco: Jossey Bass.

Warner, A. (2016). The aim of the game: how the gamification of medtech is putting the fun into healthier behavior. Retrieved March 28, 2017, from <https://medtechengine.com/article/gamification-in-healthcare/>

Werbach, K., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business*. Wharton Digital Press.

Wijndaele, K., Matton, L., Duvinéaud, N., Lefevre, J., De Bourdeaudhuij, I., Duquet, W., ... & Philippaerts, R. M. (2007). Association between leisure time physical activity and stress, social support and coping: A cluster-analytical approach. *Psychology of Sport and Exercise*, 8(4), 425-440.



Wixon, D. (2011). Measuring fun, trust, confidence, and other ethereal constructs: it isn't that hard. *interactions*, 18(6), 74-77.

World Health Organization. (1995). Constitution of the world health organization.

Yuxiang, Z. H. A. O., & Qinghua, Z. H. U. (2009). Blog acceptance model: An empirical study on exploring users' acceptance and continual usage of blogs.

Zorginzicht. (2017). HKT-R zelfscore app: Behandelevaluatie / risicotaxatie instrument. Retrieved March 28, 2017, from <https://www.zorginzicht.nl/bibliotheek/hkt-r-zelfscore-app/Paginas/Home.aspx>

## Appendices

|  |     |
|--|-----|
| Appendix A. Description of the clinical risk factors of the HKT-R .....          | 87  |
| Appendix B. Description of the Game Element Hierarchy.....                       | 88  |
| Appendix C. Literature review.....   | 89  |
| Appendix D. Pre-test questionnaire .....   | 95  |
| Appendix E. Intermediate interview: Non-unified versus unified design.....       | 99  |
| Appendix F. Post-test questionnaire and interview.....                           | 101 |
| Appendix G. Planning.....  | 104 |
| Appendix H. Screenshots GameBus for design space definition.....                 | 105 |
| Appendix I. Decision table activities based on HKT .....                         | 106 |
| Appendix J. Decision table activities for GameBus challenge .....                | 107 |
| Appendix K. Visual representation smart scoring systems .....                    | 108 |
| Appendix L. Template decision table.....   | 111 |
| Appendix M. Screenshots GameBus challenges .....                                 | 112 |
| Appendix N. Reliability of scales and normality test .....                       | 118 |
| Appendix O. Results paired t-tests.....  | 119 |
| Appendix P. Coding scheme of interviews.....                                     | 121 |
| Appendix Q. Personas creation.....   | 123 |
| Appendix R. Developed personas for evaluation of scoring systems .....           | 124 |
| Appendix S. Post-test smart scoring systems for employees.....                   | 125 |
| Appendix T. Evaluations scoring systems by employees .....                       | 134 |
| Appendix U. Overview hospitalization planning.....                               | 136 |
| Appendix V. Weightings activities for HKT-scores .....                           | 137 |
| Appendix W. Decision tables recommended and default values scoring systems ..... | 138 |
| Appendix X. Quick design decision support tool.....                              | 141 |
| Appendix Y. Results testing decision support tool.....                           | 145 |
| Appendix Z. Typed and coded interviews .....                                     | 147 |

## **List of figures in appendices**

|  |     |
|--|-----|
| Figure 30. Framework literature review. ....                               | 92  |
| Figure 31. Planning master thesis project. ....                            | 104 |
| Figure 32. Process GameBus challenge design. ....                          | 105 |
| Figure 33. Visual representation increasing scoring system. ....           | 108 |
| Figure 34. Visual representation decreasing scoring system. ....           | 108 |
| Figure 35. Visual representation baseline improvement scoring system. .... | 108 |
| Figure 36. Visual representation limit scoring system. ....                | 109 |
| Figure 37. Visual representation goal completion scoring system. ....      | 109 |
| Figure 38. Visual representation HKT-adjustment scoring system. ....       | 109 |
| Figure 39. Visual representation adjusted leaderboard scoring system. .... | 110 |
| Figure 40. Personas based on pilot. ....                                   | 124 |
| Figure 41. Decision tree start. ....                                       | 141 |
| Figure 42. Decision tree hospitalization phase. ....                       | 142 |
| Figure 43. Decision tree treatment phase. ....                             | 143 |
| Figure 44. Decision tree resocialization phase. ....                       | 144 |

## List of tables in appendices

|  |     |
|--|-----|
| Table 22. Description of each risk factor.....                             | 87  |
| Table 23. Description of the game dynamics.....                            | 88  |
| Table 24. Description of the game mechanics. ....                          | 88  |
| Table 25. Description of the game components.....                          | 88  |
| Table 26. Search queries literature review.....                            | 89  |
| Table 27. Articles retrieved from search queries. ....                     | 89  |
| Table 28. Citation chase results. ....                                     | 90  |
| Table 29. Overview of goals used in gamification for health.....           | 92  |
| Table 30. Overview of game dynamics used in gamification for health.....   | 93  |
| Table 31. Overview of game mechanics used in gamification for health.....  | 93  |
| Table 32. Overview of game components used in gamification for health..... | 93  |
| Table 33. Activities per risk factor.....                                  | 106 |
| Table 34. Decision table activities for GameBus challenge. ....            | 107 |
| Table 35. Template decision table for best design.....                     | 111 |
| Table 36. Cronbach's alpha values.....                                     | 118 |
| Table 37. Shapiro-Wilk test values. ....                                   | 118 |
| Table 38. Paired Samples Statistics for 'SDT'.....                         | 119 |
| Table 39. Paired Samples Test for 'SDT' . ....                             | 119 |
| Table 40. Paired Samples Statistics for 'Motivation'.....                  | 119 |
| Table 41. Paired Samples Test for 'Motivation'. ....                       | 119 |
| Table 42. Paired Samples Statistics for 'Fun'. ....                        | 119 |
| Table 43. Paired Samples Test for 'Fun'.....                               | 120 |
| Table 44. Paired Samples Statistics for 'Fairness'.....                    | 120 |
| Table 45. Paired Samples Test for 'Fairness'. ....                         | 120 |
| Table 46. Nodes overview with references from interview. ....              | 121 |
| Table 47. Characteristics pilot participants.....                          | 123 |
| Table 48. Employee evaluation of scoring systems.....                      | 134 |
| Table 49. Hospitalization planning personality. ....                       | 136 |
| Table 50. Hospitalization planning psychosis.....                          | 136 |
| Table 51. Weightings for activities per HKT risk factor. ....              | 137 |
| Table 52. Scoring systems for care path psychosis.....                     | 138 |
| Table 53. Scoring systems for care path personality.....                   | 138 |
| Table 54. Results testing decision support tool per persona. ....          | 145 |

## Appendix A. Description of the clinical risk factors of the HKT-R

Table 22. Description of each risk factor.

| <b>Risk factor</b>           | <b>Description</b>   |
|------------------------------|--|
| <b>Influenceability</b>      | The extent to which the client has been affected by other people in the last twelve months. It is not about the professionals, but about fellow clients, family, friends, etc. that can have a protective and/or risky influence on the client behavior.   |
| <b>Problem understanding</b> | The degree in which the client had been aware of his/her specific risk factors and signals of risky behavior in risky situations in the last twelve months. In addition, the degree in which the client is behaving in line with this understanding is also important for this risk factor.                  |
| <b>Psychoses</b>             | The degree in which the clients has shown psychotic symptoms in the last twelve months. In addition, the severity and the effect of these symptoms on possibly aggressive behavior are of importance as well.  |
| <b>Addiction</b>             | The frequency of the controversial use of alcohol, soft drugs and/or hard drugs by patients during the last twelve months.   |
| <b>Impulsiveness</b>         | The extent to which the client has shown unpredictable and/or thoughtless behavior and as a consequence, was a burden to himself or to other in the last twelve months.  |
| <b>Antisocial behavior</b>   | The degree in which the client has pursued his/her own interest without taking into account the feelings or interests of others or the circumstances in the last twelve months. As a consequence, the clients has previously and/or more often encountered conflict, possibly leading to violent situations. |
| <b>Hostility</b>             | The extent to which the client has shown hostile behavior in the last twelve months. This can be either verbal or physical hostile behavior.   |
| <b>Social behavior</b>       | The degree in which the client is able to maintain contacts in an acceptable and satisfactory manner with his or her own living and working environment during the last twelve months.   |
| <b>Self-reliance</b>         | The degree in which the client is able to fulfill the essential daily tasks such as personal hygiene and eating and sleep habits in the last twelve months.  |
| <b>Treatment readiness</b>   | The amount of effort from the patient to make progress in their treatment.   |
| <b>Responsibility</b>        | The extent to which the clients accepts the offenses committed by him/her and acknowledges responsibility for it.  |
| <b>Coping skills</b>         | The degree in which the client has demonstrated the right skills in the last twelve months to resolve the situation satisfactory when he or she is confronted with events that require adjustment.   |
| <b>Appointments</b>          | In the treatment, agreements are made and conditions are set regarding treatment and engagement. This risk factor is about the extent to which the client complies to these agreements.  |
| <b>Labor skills</b>          | The degree to which the clients was able to work properly in the past twelve months. Work can be performed both inside and outside DWP (depending on the security level of a client).  |

## Appendix B. Description of the Game Element Hierarchy

Table 23. Description of the game dynamics.

| Game Dynamics        | Description   |
|----------------------|---|
| <b>Constraints</b>   | Limiting the freedom of the user, forcing them to make trade-offs and using their creativity                          |
| <b>Emotions</b>      | Emotions that occur during the serious game, such as curiosity, competitiveness, frustration, happiness and so on     |
| <b>Narrative</b>     | An ongoing storyline that puts together the pieces of the game  |
| <b>Progression</b>   | The player's growth and development in the game which gives them a sense of achievement and an opportunity to improve |
| <b>Relationships</b> | The social interactions with friends, teammates and opponents that are implemented in the game                        |

Table 24. Description of the game mechanics.

| Game Mechanics              | Description  |
|-----------------------------|--|
| <b>Challenges</b>           | Puzzles or other tasks that require effort to solve                              |
| <b>Chance</b>               | Random elements that are implemented in the game                                 |
| <b>Competition</b>          | A competitive environment in which one player or group wins, and the other loses |
| <b>Cooperation</b>          | A cooperative environment in which players can achieve goals by working together |
| <b>Feedback</b>             | Information that shows how the player is doing                                   |
| <b>Resource Acquisition</b> | Obtaining items that are collectible or useful                                   |
| <b>Rewards</b>              | Specific achievements or actions will be benefitted                              |
| <b>Transactions</b>         | The possibility of trading between players                                       |
| <b>Turns</b>                | Sequential participation by alternating the players                              |
| <b>Win States</b>           | Objectives that make one player or group the winner                              |

Table 25. Description of the game components.

| Game Components          | Description  |
|--------------------------|--|
| <b>Achievements</b>      | A specific set of objectives   |
| <b>Avatars</b>           | A visual representation of the player's character                                    |
| <b>Badges</b>            | A visual representation of the achievements  |
| <b>Boss Fights</b>       | A particularly difficult challenge that will get the player to the next level        |
| <b>Collection</b>        | Set of items or badges that can be achieved  |
| <b>Combat</b>            | A defined battle, which is typically of short duration                               |
| <b>Content Unlocking</b> | Some specific things that a person can get only when they reach a specific objective |
| <b>Gifting</b>           | The possibility to share resources with other players                                |
| <b>Leaderboards</b>      | A visual representation of player progression and achievement                        |
| <b>Levels</b>            | Defined steps in the progression of the player                                       |
| <b>Points</b>            | Numerical representation of the progression of the player                            |
| <b>Quests</b>            | Predefined challenges with objectives and rewards                                    |
| <b>Social Graphs</b>     | A representation of the players' social network within the game                      |
| <b>Teams</b>             | A group of players that work together for a common goal                              |
| <b>Virtual Goods</b>     | Assets in the game that have perceived or real monetary value                        |

## Appendix C. Literature review

### Step 1: Insert search queries in databases

Table 26. Search queries literature review.

| Database                    | FOCUS  | ProQuest   | Web of Science   | Scopus   |
|-----------------------------|--|--|--|--|
| <b>Search query</b>         | ((Abstract:(("serious gam*")) OR (Abstract:(("game based learning")) OR (Abstract:(gamification))) AND ((Abstract:(client)) OR (Abstract:(patient)) OR (Abstract:(customer))) AND (Fulltext:(Goal*)) AND ((Fulltext:(Motivat*)) OR (Fulltext:(Incentive))) Date: After 2000 Full text online Language: English | (ab((client OR patient OR customer)) AND ab((gamification OR ("serious gam*") OR ("game based learning")))) AND ft(goal*) AND ft((motivat* OR incentive)) full text additional limits: Date: After 2000; Language: English | ((TS = ((("serious gam*") OR ("game based learning")) OR gamification) AND (client OR patient OR customer) AND (goal*) AND (motivat* OR incentive)))) AND (English) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=2000-2017 | TITLE-ABS-KEY ( ( "serious gam*" OR gamification OR "game based learning" ) AND (client OR patient OR customer) AND goal* AND (motivat* OR incentive) ) AND PUBYEAR > 2000 AND ( LIMIT-TO ( DOCTYPE,"cp " ) OR LIMIT-TO ( DOCTYPE," ar " ) OR LIMIT-TO ( DOCTYPE," ch " ) ) AND ( LIMIT-TO ( LANGUAGE,"English " ) ) |
| <b>Publication in years</b> | 2000-2017  | 2000-2017  | 2000-2017  | 2000-2017  |
| <b>Language</b>             | English  | English  | English  | English  |
| <b>Results</b>              | 50   | 50   | 16   | 23   |

### Step 2: Review and select articles (black articles are selected), continue with citation chase

Table 27. Articles retrieved from search queries.

| Article Title  | Authors   |
|--|---|
| [48] A game plan: Gamification design principles in mHealth applications for chronic disease management  | A.S. Miller, J.A. Cafazzo, E. Seto  |
| [49] A participatory game design approach for children after cancer treatment                            | F. Kayali, K. Peters, A. Reithofer, R. Mateus-Berr, Z. Lehner, D. Martinek, M. Sprung, M. Silbernagl, R. Woelfle, A. Lawitschka, H. Hlavacs |
| [50] Active-U: Playing to stimulate your brain   | M. Garolera, N. Berga, M. Quintana, G. Chico, N. Cerulla, M. Lopez, Y. Donaire, J. Rimbau   |
| [51] Adaptation in serious games for upper-limb rehabilitation: an approach to improve training outcomes | N. Hocine, A. Gouaïch, S. A. Cerri, D. Mottet, J. Froger, I. Laffont  |
| [52] Application of serious games in ankle-foot orthotic rehabilitation                                  | Z. Jiang, D. Stajsic  |
| [53] Creating a serious game for health  | J.M. Clochesy, M. Buchner, R.L. Hickman, M.D. Pinto, K. Znamenak  |

|      |   |  |
|------|---|--|
| [54] | <b>Engaging children in play therapy: The coupling of virtual reality games with social robotics</b>  | S. Garcia-Vergara, L. Brown, H.W. Park, A.M. Howard  |
| [55] | Executive Functioning in Alcoholics Following an mHealth Cognitive Stimulation Program: Randomized Controlled Trial                             | P. Gamito, J. Oliveira, P. Lopes, R. Brito, D. Morias, D. Silva, A. Silva, S. Rebelo, M. Bastos, A. Deus   |
| [56] | <b>Exergaming and rehabilitation: A methodology for the design of effective and safe therapeutic exergames</b>                                  | M. Pirovano, E. Surer, R. Mainetti, P.L. Lanzi, N.A. Borghese  |
| [57] | Game-based learning and Gamification to promote engagement and motivation in medical learning contexts  | E. Pesare, T. Roselli, N. Corriero, V. Rossano   |
| [58] | <b>Gamifying Self-Management of Chronic Illnesses: A Mixed-Methods Study</b>  | A. AlMarshedi, G. Wills, A. Ranchhod   |
| [59] | <b>Intelligent game engine for rehabilitation (IGER)</b>  | M. Pirovano, R. Maintetti, G. Baud-Body, P. Luca Lanzi, N.A. Borghese  |
| [60] | <b>Mysterious Bones Unearthed: development of an online therapeutic serious game for children with attention deficit-hyperactivity disorder</b> | R. Rijo, P. Costa, P. Machado, D. Bastos, P. Matos. A. Silva, J. Ferrinho, N. Almeida, A. Oliveira, S. Xavier, S. Santos, C. Oliveira, S. Brites, V. Martins, A. Pereira, S. Fernandes |
| [61] | <b>Serious games for health: An empirical study of the game “Balance” for teenagers with diabetes mellitus</b>                                  | A. Fuchslocher, J. Niesenhaus, N. Krämer   |
| [62] | <b>Serious Games for Movement Therapy after Stroke</b>  | M. Ma, K. Bechkoum   |
| [63] | THERAPIST: Towards an Autonomous Socially Interactive Robot for Motor and Neurorehabilitation Therapies for Children                            | L.V. Calderita, P. Bustos, C.S. Mejías, F. Fernandez, A. Bandera   |
| [64] | <b>Using Mobile Serious Games in the Context of Chronic Disorders: A Mobile Game Concept for the Treatment of Tinnitus</b>                      | M. Schickler, R. Pryss, M. Reichert, J. Schobel, B. Langguth, W. Schlee  |
| [65] | <b>Virtual Reality for Pediatric Neuro-Rehabilitation: Adaptive Visual Feedback of Movement to Engage the Mirror Neuron System</b>              | R. Kommalapati, K.P. Michmizos   |

Table 28. Citation chase results.

| Article Title  | Authors   |
|--|---|
| [66] <b>A game system for cognitive rehabilitation</b>   | A. Shapi’I, N.A.M. Zin, A.M. Elaklouk                             |
| [67] A video game improves behavioral outcomes in adolescents and young adults with cancer: A randomized trial | P.M. Kato, S.W. Cole, A.S. Bradlyn, B.H. Pollock                  |
| [68] Clinical trial design of serious gaming in mild cognitive impairment                                      | C. Musclo, P. Tiraboschi, U.P. Guerra, C.A. Defanti, G.B. Frisoni |
| [69] Computer games for the elderly  | G.R. Whitcomb   |



- 
- [70] Design of an mHealth App for the Self-management of Adolescent Type 1 Diabetes: A Pilot Study J.A. Cafazzo, M. Casselman, N. Hamming, D.K. Katzman, M.R. Palmert
- [71] Evaluating social games for kids and teenagers diagnosed with cancer A. Fuchslocher, K. Gerling, M. Masuch, N. Krämer
- [72] Gamified platform to support children with obesity Y. Del Cristo Barrios Fleitas, C. Soledad Gonzalez, E. Lalla-Ruiz, P. Toledo
- [73] Getting into the game N. Martin
- [74] Immersive Virtual Reality for Upper Limb Rehabilitation Following Stroke M. McNeil, L. Pokluda, S. McDonough, J. Crosbie
- [75] Improving Patient Motivation in Game Development for Motor Deficit Rehabilitation E. Flores, G. Tobon, E. Cavallaro, F.I. Cavallaro, J.C. Perry, T. Keller
- [76] Incorporating the Rehabilitation of Parkinson's Disease in the Play for Health Platform Using a Body Area Network F. Tous, P. Ferriol, M.A. Alcade, M. Melia, B. Milosevic, M. Hardegger, D. Roggen
- [77] Increasing the Efficacy of Rehabilitation Protocols for Children via a Robotic Playmate Providing Real-time Corrective Feedback S. Garcia-Vergara, L. Brown, Y-P. Chen, A.M. Howard
- [78] Intelligent Serious Games System for Children with Learning Disabilities G.A. El Khayat, T.F. Mabrouk, A.S. Elmaghraby
- [79] Kid-Ney's Journey: a Game to Support Treatment Selection for People with Chronic Kidney Failure A.C. Vis
- [80] Locomotor Training and Virtual Reality-based Balance Training for an Individual with Multiple Sclerosis: A Case Report G.D. Fulle
- [81] Management of chronic pediatric diseases with interactive health games: Theory and research findings D.A. Lieberman
- [82] Mobile apps for chronic disease management: lessons learned from myFitnessCompanion P. Leijdekkers, V. Gay
- [83] Mobile-Web App to Self-Manage Low Back Pain: Randomized Controlled Trial A.B. Irvine, H. Russell, M. Manocchia, D.E. Mino, T. Cox Glassen, R. Morgan, J.M. Gau, A.J. Birney, D.V. Ary
- [84] MyDailyRoutine - A Serious Game to Support People Suffering from a Cerebral Dysfunction R. Baranyi, R. Perndorfer, N. Lederer, B. Scholz, T. Grechenig
- [85] Optimizing engagement for stroke rehabilitation using serious games J.W. Burke, M.D.J. McNeill, D.K. Charles, P.J. Morrow, J.H. Crosbie, S.M. McDonough
- [86] RehabCity: Design and Validation of a Cognitive Assessment and Rehabilitation Tool through Gamified Simulations of Activities of Daily Living A. Vourvopoulos, A.L. Faria, K. Ponnam, S. Bermudez I Badia
- [87] Self-Adaptive Games for Rehabilitation at Home M. Pirovano, R. Mainetti, G. Baud-Bovy, P.L. Lanzi, N.A. Borghese
-

|  |  |
|--|--|
| [88] Serious Games for Health – Personalized Exergames   | S. Göbel, S. Hardy, V. Wendel, F. Mehm, R. Steinmetz   |
| [89] Serious Games for Upper Limb Rehabilitation Following Stroke  | J.W. Burke, M.D.J. McNeill, D.K. Charles, P.J. Morrow, J.H. Crosbie, S.M. McDonough  |
| [90] Serious games in prevention and rehabilitation—a new panacea for elderly people?                                  | J. Wiemeyer, A. Kliem  |
| [91] Use of X-box Kinect Gaming Console for Rehabilitation of an Individual with Traumatic Brain Injury: A Case Report | J.M. Paavola, K.E. Oliver, K.I. Ustinova   |
| [92] Video game training enhances cognitive control in older adults  | J.A. Anguera, J. Boccanfuso, J.L. Rintoul, O. Al-Hashimi, F. Faraji, J. Janowich, E. Kong, Y. Larraburo, C. Rolle, E. Johnston, A. Gazeley |
| [93] Virtual Rehabilitation Environment Using Principles of Intrinsic Motivation and Game Design                       | M. Mihelj, D. Novak, M. Milavec, J. Zihlerl, A. Olsensek, M. Munih   |
| [94] WristDroid – a Serious Game to Support and Motivate Patients throughout their Wrist Rehabilitation                | R. Baranyi, F. Reisecker, N. Lederer, M. Gobber, T. Grechenig  |

### Step 3: Develop framework for reviewing articles

| Purpose Serious Game  | Game Dynamics  | Game Mechanics  | Game Components  |
|---|--|---|--|
| <ul style="list-style-type: none"> <li>• Prevention</li> <li>• Therapeutic</li> <li>• Assessment</li> <li>• Education</li> <li>• Informatics</li> </ul> | <ul style="list-style-type: none"> <li>• Constraints</li> <li>• Emotions</li> <li>• Narrative</li> <li>• Progression</li> <li>• Relationships</li> </ul> | <ul style="list-style-type: none"> <li>• Challenges</li> <li>• Chance</li> <li>• Feedback</li> <li>• Resource Acquisition</li> <li>• Rewards</li> <li>• Win States (One player)</li> <li>• Competition</li> <li>• Cooperation</li> <li>• Transactions</li> <li>• Turns</li> <li>• Win States (Group)</li> </ul> | <ul style="list-style-type: none"> <li>• Achievements</li> <li>• Avatars</li> <li>• Badges</li> <li>• Boss Fights</li> <li>• Collections</li> <li>• Combat</li> <li>• Content Unlocking</li> <li>• Levels</li> <li>• Points</li> <li>• Quests</li> <li>• Virtual Goods</li> <li>• Gifting</li> <li>• Leaderboards</li> <li>• Social Graphs</li> <li>• Teams</li> </ul> |

Figure 30. Framework literature review.

### Step 4: Review articles with terms or synonyms of framework

Table 29. Overview of goals used in gamification for health.

| Goal        | Used in study  | Total number of studies |
|-------------|--|-------------------------|
| Prevention  | [51] [55] [58] [59] [61] [79] [88] [90] [91] [93]  | 10                      |
| Therapeutic | [49] [51] [52] [54] [55] [58] [59] [60] [61] [62] [64] [65] [66]<br>[71] [72] [75] [79] [81] [84] [85] [86] [87] [89] [91] [93] [94] | 26                      |
| Assessment  | [49] [59] [72] [78] [86]   | 5                       |

|             |                          |   |
|-------------|--------------------------|---|
| Education   | [50] [61] [78] [79] [84] | 5 |
| Informatics | [72] [79] [87]           | 3 |

Table 30. Overview of game dynamics used in gamification for health.

| Game Dynamics | Used in study  | Total number of studies |
|---------------|--|-------------------------|
| Constraints   | [55] [61] [65] [78] [79] [87] [91] [93] [94]           | 9                       |
| Emotions      | [49] [51] [54] [58] [59] [61] [71] [87] [90] [93]      | 10                      |
| Narrative     | [49] [50] [51] [59] [60] [61] [71] [72] [79] [88] [90] | 11                      |
| Progression   | [51] [55] [58] [59] [62] [66] [85] [86] [89]           | 9                       |
| Relationships | [49] [54] [58] [60] [71] [90]                          | 6                       |

Table 31. Overview of game mechanics used in gamification for health.

| Game Mechanics          | Used in study  | Total number of studies |
|-------------------------|--|-------------------------|
| Challenges              | [49] [50] [51] [55] [58] [59] [60] [61] [64] [65] [66] [75] [79] [84] [85] [86] [87] [88] [89] [90] [91] [93] [94] | 23                      |
| Chance                  | [51] [52] [58] [59] [62] [66] [78] [84] [85] [88] [90] [94]  | 12                      |
| Feedback                | [50] [51] [54] [55] [58] [59] [61] [62] [64] [65] [66] [75] [78] [79] [84] [85] [86] [87] [89] [90] [91] [93] [94] | 23                      |
| Resource Acquisition    |  |                         |
| Rewards                 | [49] [50] [51] [55] [58] [65] [72] [79] [85] [86] [89] [91] [93] [94]  | 14                      |
| Win States (One player) |  |                         |
| Competition             | [49] [58] [62] [88]  | 4                       |
| Cooperation             | [59] [61] [71] [87] [88] [90] [93]   | 7                       |
| Transactions            |  |                         |
| Turns                   | [54] [55] [58] [79] [85] [86] [89]   | 7                       |
| Win States (Group)      |  |                         |

Table 32. Overview of game components used in gamification for health.

| Game Components   | Used in study  | Total number of studies |
|-------------------|--|-------------------------|
| Achievements      | [51] [54] [66] [71] [72] [84]  | 6                       |
| Avatars           | [55] [59] [61] [65] [84] [85] [87] [89] [90] [94]  | 10                      |
| Badges            | [58] [94]  | 2                       |
| Boss Fights       |  |                         |
| Collections       |  |                         |
| Combat            | [49]   | 1                       |
| Content Unlocking | [50] [79] [84] [94]  | 4                       |
| Levels            | [49] [50] [51] [52] [54] [58] [59] [60] [62] [64] [66] [84] [85] [86] [87] [88] [89] [90] [91] [93] [94] | 21                      |

---

|               |  |    |
|---------------|--|----|
| Points        | [49] [51] [54] [55] [58] [59] [61] [64] [72] [84] [85] | 16 |
|               | [86] [89] [91] [93] [94]                               |    |
| Quests        | [51] [64]  | 2  |
| Virtual Goods | [66]   | 1  |
| Gifts         |  |    |
| Leaderboards  | [58] [62] [88]   | 3  |
| Social Graphs |  |    |
| Teams         | [79] [88]  | 2  |

---

## Appendix D. Pre-test questionnaire

Naam: .....

Datum: .....

### Zelfdeterminatie theorie

|    |  | Helemaal niet<br>mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee<br>eens |
|----|--|---------------------------|---------------|----------|----------|----------------------|
| 1  | Ik heb het gevoel dat ik erg veel vooruitgang heb geboekt met relatie tot het doel wat ik wil bereiken                       | 1                         | 2             | 3        | 4        | 5                    |
| 2  | De manier waarop ik de activiteiten van mijn behandelprogramma uitvoer zijn in overeenstemming met mijn keuzes en interesses | 1                         | 2             | 3        | 4        | 5                    |
| 3  | Ik heb het gevoel dat ik succesvol de activiteiten van mijn behandelprogramma uitvoer  | 1                         | 2             | 3        | 4        | 5                    |
| 4  | De relatie die ik heb met de mensen binnen DWP zijn zeer vriendelijk   | 1                         | 2             | 3        | 4        | 5                    |
| 5  | Ik heb het gevoel dat ik mijn activiteiten uitvoer op de manier hoe ik het wil   | 1                         | 2             | 3        | 4        | 5                    |
| 6  | Ik heb het gevoel dat ik mijn activiteiten goed uitvoer  | 1                         | 2             | 3        | 4        | 5                    |
| 7  | Ik heb het gevoel dat ik een goede communicatie heb met de mensen binnen DWP   | 1                         | 2             | 3        | 4        | 5                    |
| 8  | Ik heb het gevoel dat de activiteiten die ik uitvoer een weerspiegeling zijn van mezelf                                      | 1                         | 2             | 3        | 4        | 5                    |
| 9  | Ik kan de vereisten van mijn behandelprogramma goed uitvoeren  | 1                         | 2             | 3        | 4        | 5                    |
| 10 | De relatie die ik heb met de mensen binnen DWP is erg hecht  | 1                         | 2             | 3        | 4        | 5                    |
| 11 | Ik heb het gevoel dat ik zelf keuzes kan maken wat betreft de activiteiten die ik uitvoer binnen mijn behandelprogramma      | 1                         | 2             | 3        | 4        | 5                    |

### Motivatie

Waarom voer je de activiteiten binnen je behandelprogramma uit?

|   |   | Helemaal niet<br>mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee<br>eens |
|---|---|---------------------------|---------------|----------|----------|----------------------|
| 1 | Omdat ik denk dat het interessant is                          | 1                         | 2             | 3        | 4        | 5                    |
| 2 | Omdat ik het doe voor mijn eigen bestwil                      | 1                         | 2             | 3        | 4        | 5                    |
| 3 | Omdat het fijn is om deze activiteiten uit te voeren          | 1                         | 2             | 3        | 4        | 5                    |
| 4 | Omdat ik denk dat het goed voor me is                         | 1                         | 2             | 3        | 4        | 5                    |
| 5 | Omdat het leuk is   | 1                         | 2             | 3        | 4        | 5                    |
| 6 | Omdat ik hier persoonlijk voor kies                           | 1                         | 2             | 3        | 4        | 5                    |
| 7 | Omdat ik me goed voel wanneer ik ze uitvoer                   | 1                         | 2             | 3        | 4        | 5                    |
| 8 | Omdat ik geloof dat deze activiteiten belangrijk zijn voor me | 1                         | 2             | 3        | 4        | 5                    |

## **HKT-R**

### **Probleeminzicht: Stel je komt in een lastige situatie terecht:**

- Ik weet wanneer ik een probleem heb en ga hier op een goede manier mee om
- Ik weet wat bij mij gedrag uitlokt waar anderen last van hebben. Het lukte me in het afgelopen jaar niet altijd om er op een goede manier mee om te gaan
- Ik weet nog niet precies wat bij mij negatief gedrag uitlokt. Ik wil dat uitzoeken
- Ik denk niet dat mijn omgeving mij zal uitlokken tot negatief gedrag. Daarom zie ik er noodzaak niet van in om dat verder uit te zoeken
- Ik herken negatieve invloed vanuit mijn omgeving en laat me er niet door leiden

### **Psychoses: Heb jij ongewone ervaringen, gedachten en gevoelens?**

- Ik heb in het afgelopen jaar geen ongewone ervaringen gehad die anderen niet snapt
- Ik heb weleens ongewone ervaringen gehad, maar die maakten me niet bang of agressief
- Ik heb in het afgelopen jaar weleens ongewone ervaringen waardoor ik ging schelden of dreigen
- Ik heb in het afgelopen jaar weleens ongewone ervaringen gehad waardoor ik ging schelden, dreigen of anderen te lijf ging
- Ik heb in het afgelopen jaar vaker ongewone ervaringen gehad waardoor ik lichamelijk agressief ben geworden naar anderen

### **Verslaving: Heb je een verslaving? Hoe ga jij er dan mee om?**

- Ik heb in het afgelopen jaar geen behoefte gehad aan verslavende middelen
- Ik heb in het afgelopen jaar wel behoefte gehad aan middelengebruik maar heb er niet aan toegegeven
- Ik heb in het afgelopen jaar wel behoefte gehad en heb hier in het afgelopen jaar ook een enkele keer aan toegegeven
- Ik heb in het afgelopen jaar wel behoefte gehad en heb hier ook meerdere keren aan toegegeven
- Ik heb in het afgelopen jaar meerdere keren middelen gebruikt. Ook als anderen aangaven dat het verstandiger is om te stoppen

### **Impulsiviteit: Hoe goed denk jij na voordat je iets beslist of doet?**

- Ik denk altijd goed na over mogelijke consequenties voordat ik iets doe
- Ik heb het afgelopen jaar weleens dingen gedaan in een opwelling, ik zorg daarbij dat ik anderen niet tot last ben
- Ik heb het afgelopen jaar weleens dingen gedaan voordat ik goed had nagedacht over de gevolgen de consequenties waren te overzien
- Ik heb het afgelopen jaar vaker dingen in een opwelling gedaan. Daarmee heb ik mezelf of anderen weleens in de problemen gebracht
- Ik doe gewoon wat ik wil doen en zie wel wat er daarna gebeurt

### **Antisociaal gedrag: Hoe belangrijk vind jij het om rekening te houden met andere mensen?**

- Ik weet wat anderen in de omgang met mij van mij verwachten en pas me aan als ik merk dat andere mensen last van mijn gedrag hebben
- Ik overtreed de omgangsregels weleens maar dat heeft me in het afgelopen jaar geen problemen opgeleverd
- Ik weet niet altijd precies welke regels er gelden in de omgang met anderen. Daardoor heb ik in het afgelopen jaar weleens ruzie gekregen

- Ik vind het lastig om rekening te houden met anderen. In het afgelopen jaar lukte dat soms niet en ging ik bijvoorbeeld schelden, dreigen of vechten
- Ik ben wie ik ben en doe zoals ik doe ook als anderen daar last van hebben. Andere mensen moeten dat maar accepteren

**Vijandigheid: Wat doe jij als je prikkelbaar bent?**

- Ik ben van mezelf niet zo gevoelig voor negatieve prikkels
- Ik voorzie soms dat anderen het niet goed met mij voor hebben en reageer dan met schelden of iemand beledigen
- Anderen hebben het vaker niet goed met mij voor. Ik heb dan de neiging om te gaan schelden of anderen te beledigen. Dat is het afgelopen jaar wel voorgekomen
- Anderen zijn tegen mij daarom ging ik in het afgelopen jaar wel eens dreigen of met spullen of deuren smijten
- Anderen zijn er altijd op uit om mij een hak te zetten. Ik heb daarom de neiging om te slaan of te schoppen. Dat is het afgelopen jaar ook wel gebeurd

**Sociaal gedrag: Hoe zijn jouw sociale vaardigheden?**

- Ik weet me passend te gedragen ten opzichte van andere mensen
- Mijn sociale vaardigheden zijn redelijk
- Ik weet hoe ik me passend moet gedragen maar vind het soms lastig om dat ook de hele tijd te blijven doen
- Het is mij niet altijd duidelijk welke hoe ik me tot anderen moet verhouden in verschillende situaties. Daar voel ik me weleens onzeker door en daardoor loopt het soms mis
- Ik weet vaak niet hoe ik moet voorkomen dat anderen mij anders vinden of boos op mij reageren

**Zelfredzaamheid: Hoe staat het met jouw zelfzorg?**

- Ik kan goed voor mezelf zorgen
- Sommige dingen vind ik moeilijk om zelfstandig op te pakken
- Sommige dingen kan ik niet goed zelfstandig, maar dat heeft me het afgelopen jaar geen problemen opgeleverd
- Ik vind het lastig om goed voor mezelf te zorgen, hierdoor heb ik het afgelopen jaar weleens problemen gekregen met anderen
- Ik kan niet voor mezelf zorgen. Dit heeft het afgelopen jaar ernstige problemen veroorzaakt voor de gezondheid en/of de veiligheid van mijzelf en/of anderen

**Behandelbereidheid: Zet jij je in voor alle behandeldoelen?**

- Ik werk actief mee aan alle onderdelen van mijn behandeling
- Ik werk mee maar vind niet alle behandeldoelen even belangrijk als het team
- Soms werk ik mee en soms ook niet, dat wisselde het afgelopen jaar per keer
- Ik zie de zin van mijn behandeling niet echt in en heb er daarom het afgelopen jaar niet meer gedaan dan nodig was
- Ik vind behandeling niet noodzakelijk of zinvol en heb het afgelopen jaar geen gebruik gemaakt van het behandelaanbod

**Verantwoordelijkheid: Ben jij schuldig aan het delict en vind je behandeling nodig?**

- Ik ben het er mee eens en zie in waarom ik behandeld moet worden

- Ik ben het ermee eens dat ik behandeld moet worden, maar ik ben maar gedeeltelijk verantwoordelijk voor het delict
- Ik ben het er niet mee eens dat ik behandeld moet worden, ik ben maar gedeeltelijk verantwoordelijk
- Mijn probleemgedrag is niet zo ernstig dat ik daarvoor behandeling nodig zou hebben
- Ik heb geen delict gepleegd en vind dat ik onterecht in een behandelinstelling ben opgenomen

**Copingvaardigheden: Hoe ga jij om met lastige situaties?**

- Ik kan zelfstandig met lastige situaties omgaan
- Meestal lukt het mij zelf wel om moeilijke situaties op goede manier op te lossen
- Ik heb in het afgelopen jaar hulp van anderen nodig gehad om goed om te kunnen gaan met moeilijke situaties
- Het lukte mij in het afgelopen jaar niet om zelfstandig of met hulp problemen op te lossen
- Als ik in een lastige situatie zit, kom ik gegarandeerd in de problemen. Ik kan mijn gedrag op dat moment niet bijstellen, zelfs niet als ik hulp krijg van anderen

**Afspraken: Hoe ga jij om met afspraken en regels?**

- Ik houd me aan alle afspraken en regels
- Ik houd me met tegenzin aan alle afspraken en regels
- Ik kom niet alle afspraken na, maar dit levert me geen grote problemen op
- Ik doe niet meer dan strikt noodzakelijk om geen problemen te krijgen
- Ik heb ze niet bedacht en kom ze dus ook niet na

**Arbeidsvaardigheid: Hoe gaat het met jou op jouw werk of bij dagbesteding?**

- Ik heb werk/dagbesteding die aansluit op mijn behoeften
- Ik weet wat van mij wordt verwacht en werk goed samen in het afgelopen jaar
- Ik weet wat van mij wordt verwacht maar het kost me moeite aan alle verwachtingen te voldoen
- Ik vind het lastig om aan alle verwachtingen te voldoen en dit levert me soms problemen op
- Ik weet niet waarom het op mijn werk of bij dagbesteding maar niet wilt lukken

**Beïnvloedbaarheid: Welke invloed heeft jouw omgeving op jouw gedrag?**

- Ik ga alleen met mensen op die mij positief stimuleren
- Behalve met de mensen die mij steunen ga ik ook met mensen om die mij negatief kunnen beïnvloeden. Dit heeft me geen problemen opgeleverd
- Behalve met de mensen die mij steunen ga ik ook met mensen om die mij negatief kunnen beïnvloeden. Dit heeft me wel eens problemen opgeleverd
- Ik ga alleen maar met mensen om die achteraf gezien een negatieve invloed op mij hebben. Dit heeft me geen ernstige problemen opgeleverd
- Ik ga voornamelijk om met mensen die een negatieve invloed op mij hebben. Dit heeft me wel eens problemen opgeleverd



## Appendix E. Intermediate interview: Non-unified versus unified design

**Naam:** .....

**Datum:** .....

*Wat zijn je ervaringen van de wedstrijd die de eerste twee weken heeft gelopen?*

*Extra helpende vragen:*

- *Wat vond je de goede en minder goede punten aan de wedstrijd?*
- *Heb je plezier beleefd aan het meedoen met de wedstrijd?*
- *Vond je de wedstrijd eerlijk?*

*Wat zijn je ervaringen van de wedstrijd die de laatste twee heeft gelopen?*

*Extra helpende vragen:*

- *Wat vond je de goede en minder goede punten aan de wedstrijd?*
- *Heb je plezier beleefd aan het meedoen met de wedstrijd?*
- *Vond je de wedstrijd eerlijk?*

*Welke heeft je voorkeur? Waarom?*

*Hoe heeft de wedstrijd je geholpen in je behandeling?*

*Hoe motiveerde de app je om je afspraken na te komen?*

*Hoe heeft de wedstrijd je geholpen met je deelname aan sport?*

*Hoe heeft de wedstrijd je geholpen met het gebruik van Minddistrict?*

*Hoe heeft de wedstrijd je geholpen met je deelname aan arbeid/scholing/training/therapie?*

*Hoe heeft de wedstrijd je geholpen met het invullen van je agenda?*

*Zie jij voor jou persoonlijk nog verbeteringen die in GameBus ingevoerd zouden kunnen worden?*

*Heb je verder nog vragen of toevoegingen?*

### Plezier

|   |   | Helemaal niet mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee eens |
|---|---|------------------------|---------------|----------|----------|-------------------|
| 1 | Ik heb erg veel plezier beleefd aan het meedoen met GameBus         | 1                      | 2             | 3        | 4        | 5                 |
| 2 | GameBus was leuk om aan mee te doen                                 | 1                      | 2             | 3        | 4        | 5                 |
| 3 | Ik vond het meedoen met GameBus erg saai                            | 1                      | 2             | 3        | 4        | 5                 |
| 4 | Het meedoen aan GameBus heeft mijn aandacht helemaal niet getrokken | 1                      | 2             | 3        | 4        | 5                 |

|   |  |   |   |   |   |   |
|---|--|---|---|---|---|---|
| 5 | Ik zou GameBus als zeer interessant beschrijven                              | 1 | 2 | 3 | 4 | 5 |
| 6 | Ik vond GameBus zeer plezierig   | 1 | 2 | 3 | 4 | 5 |
| 7 | Het gebruiken van GameBus laat me zien hoe leuk het is om er aan mee te doen | 1 | 2 | 3 | 4 | 5 |

### Eerlijkheid

|   |  | Helemaal niet<br>mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee<br>eens |
|---|--|---------------------------|---------------|----------|----------|----------------------|
| 1 | De punten die ik kreeg gaven goed weer wat ik allemaal heb gedaan in de afgelopen weken      | 1                         | 2             | 3        | 4        | 5                    |
| 2 | De punten die ik heb gekregen waren gepast voor de hoeveelheid blokken die ik heb uitgevoerd | 1                         | 2             | 3        | 4        | 5                    |
| 3 | De eindscore weerspiegelt goed wat ik heb gedaan in de afgelopen weken                       | 1                         | 2             | 3        | 4        | 5                    |
| 4 | De uitkomsten zijn gerechtvaardigd, gezien mijn prestatie de afgelopen weken                 | 1                         | 2             | 3        | 4        | 5                    |

## Appendix F. Post-test questionnaire and interview

**Naam:** .....

**Datum:** .....

*Wat zijn je ervaringen van de laatste wedstrijd?*

*Extra helpende vragen:*

- *Wat vond je de goede en minder goede punten aan de wedstrijd?*
- *Heb je plezier beleefd aan het meedoen met de wedstrijd?*
- *Vond je de wedstrijd eerlijk?*

*Welke functies zou je nog extra willen zien in de app?*

*Wat vind je van het idee om GameBus te gebruiken als motiverende en monitorende app in je behandeling?*

*Wat zou er nog aan GameBus moeten veranderen om het ook daadwerkelijk binnen DWP in te zetten? (Denk aan support van medewerkers, activiteiten, prijzen, teams, etc.)*

*Wat is voor jou de belangrijkste reden om mee te doen met GameBus?*

*Op een schaal van 1 tot 10, wat voor cijfer zou je GameBus geven?*

### Zelfdeterminatie theorie

|   |  | Helemaal niet mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee eens |
|---|--|------------------------|---------------|----------|----------|-------------------|
| 1 | Ik heb het gevoel dat ik erg veel vooruitgang heb geboekt met relatie tot het doel wat ik wil bereiken                       | 1                      | 2             | 3        | 4        | 5                 |
| 2 | De manier waarop ik de activiteiten van mijn behandelprogramma uitvoer zijn in overeenstemming met mijn keuzes en interesses | 1                      | 2             | 3        | 4        | 5                 |
| 3 | Ik heb het gevoel dat ik succesvol de activiteiten van mijn behandelprogramma uitvoer  | 1                      | 2             | 3        | 4        | 5                 |
| 4 | De relatie die ik heb met de mensen binnen DWP zijn zeer vriendelijk   | 1                      | 2             | 3        | 4        | 5                 |
| 5 | Ik heb het gevoel dat ik mijn activiteiten uitvoer op de manier hoe ik het wil   | 1                      | 2             | 3        | 4        | 5                 |
| 6 | Ik heb het gevoel dat ik mijn activiteiten goed uitvoer  | 1                      | 2             | 3        | 4        | 5                 |
| 7 | Ik heb het gevoel dat ik een goede communicatie heb met de mensen binnen DWP   | 1                      | 2             | 3        | 4        | 5                 |
| 8 | Ik heb het gevoel dat de activiteiten die ik uitvoer een weerspiegeling zijn van mezelf                                      | 1                      | 2             | 3        | 4        | 5                 |
| 9 | Ik kan de vereisten van mijn behandelprogramma goed uitvoeren  | 1                      | 2             | 3        | 4        | 5                 |

|    |   |   |   |   |   |   |
|----|---|---|---|---|---|---|
| 10 | De relatie die ik heb met de mensen binnen DWP is erg hecht   | 1 | 2 | 3 | 4 | 5 |
| 11 | Ik heb het gevoel dat ik zelf keuzes kan maken wat betreft de activiteiten die ik uitvoer binnen mijn behandelprogramma | 1 | 2 | 3 | 4 | 5 |

### Motivatie

Waarom voer je de activiteiten binnen je behandelprogramma uit?

|   |   | Helemaal niet mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee eens |
|---|---|------------------------|---------------|----------|----------|-------------------|
| 1 | Omdat ik denk dat het interessant is                          | 1                      | 2             | 3        | 4        | 5                 |
| 2 | Omdat ik het doe voor mijn eigen bestwil                      | 1                      | 2             | 3        | 4        | 5                 |
| 3 | Omdat het fijn is om deze activiteiten uit te voeren          | 1                      | 2             | 3        | 4        | 5                 |
| 4 | Omdat ik denk dat het goed voor me is                         | 1                      | 2             | 3        | 4        | 5                 |
| 5 | Omdat het leuk is   | 1                      | 2             | 3        | 4        | 5                 |
| 6 | Omdat ik hier persoonlijk voor kies                           | 1                      | 2             | 3        | 4        | 5                 |
| 7 | Omdat ik me goed voel wanneer ik ze uitvoer                   | 1                      | 2             | 3        | 4        | 5                 |
| 8 | Omdat ik geloof dat deze activiteiten belangrijk zijn voor me | 1                      | 2             | 3        | 4        | 5                 |

### Plezier

|   |  | Helemaal niet mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee eens |
|---|--|------------------------|---------------|----------|----------|-------------------|
| 1 | Ik heb erg veel plezier beleefd aan het meedoen met GameBus                  | 1                      | 2             | 3        | 4        | 5                 |
| 2 | GameBus was leuk om aan mee te doen  | 1                      | 2             | 3        | 4        | 5                 |
| 3 | Ik vond het meedoen met GameBus erg saai                                     | 1                      | 2             | 3        | 4        | 5                 |
| 4 | Het meedoen aan GameBus heeft mijn aandacht helemaal niet getrokken          | 1                      | 2             | 3        | 4        | 5                 |
| 5 | Ik zou GameBus als zeer interessant beschrijven                              | 1                      | 2             | 3        | 4        | 5                 |
| 6 | Ik vond GameBus zeer plezierig   | 1                      | 2             | 3        | 4        | 5                 |
| 7 | Het gebruiken van GameBus laat me zien hoe leuk het is om er aan mee te doen | 1                      | 2             | 3        | 4        | 5                 |
| 8 | Ik zou GameBus aanbevelen aan andere cliënten binnen DWP                     | 1                      | 2             | 3        | 4        | 5                 |

Ik zou GameBus willen blijven gebruiken..... JA / NEE

### Eerlijkheid

|   |   | Helemaal niet mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee eens |
|---|---|------------------------|---------------|----------|----------|-------------------|
| 1 | De punten die ik kreeg gaven goed weer wat ik allemaal heb gedaan in de afgelopen weken | 1                      | 2             | 3        | 4        | 5                 |

|   |  |   |   |   |   |   |
|---|--|---|---|---|---|---|
| 2 | De punten die ik heb gekregen waren gepast voor de hoeveelheid blokken die ik heb uitgevoerd | 1 | 2 | 3 | 4 | 5 |
| 3 | De eindscore weerspiegelt goed wat ik heb gedaan in de afgelopen weken                       | 1 | 2 | 3 | 4 | 5 |
| 4 | De uitkomsten zijn gerechtvaardigd, gezien mijn prestatie de afgelopen weken                 | 1 | 2 | 3 | 4 | 5 |

### Laatste wedstrijd versus vorige wedstrijden

|   |   | Nee, het was slechter | Nee | Ja, een klein beetje | Ja, heel veel |
|---|---|-----------------------|-----|----------------------|---------------|
| 1 | Vond je dat de laatste wedstrijd leuker was dan de eerste twee wedstrijden? | 1                     | 2   | 3                    | 4             |
| 2 | Vond je dat de laatste wedstrijd leuker was dan de eerste twee wedstrijden? | 1                     | 2   | 3                    | 4             |

### Motivatie

|   |   | Nee, het is slechter | Nee | Ja, een klein beetje | Ja, heel veel |
|---|---|----------------------|-----|----------------------|---------------|
| 1 | Vond je dat je motivatie is toegenomen in vergelijking met toen we aan deze pilot begonnen? | 1                    | 2   | 3                    | 4             |

### 1 week later

*Leaderboards voorleggen, kan je mij vertellen en uitleggen wat je top 3 scoring systemen is?*

1.....

2.....

3.....

Appendix G. Planning

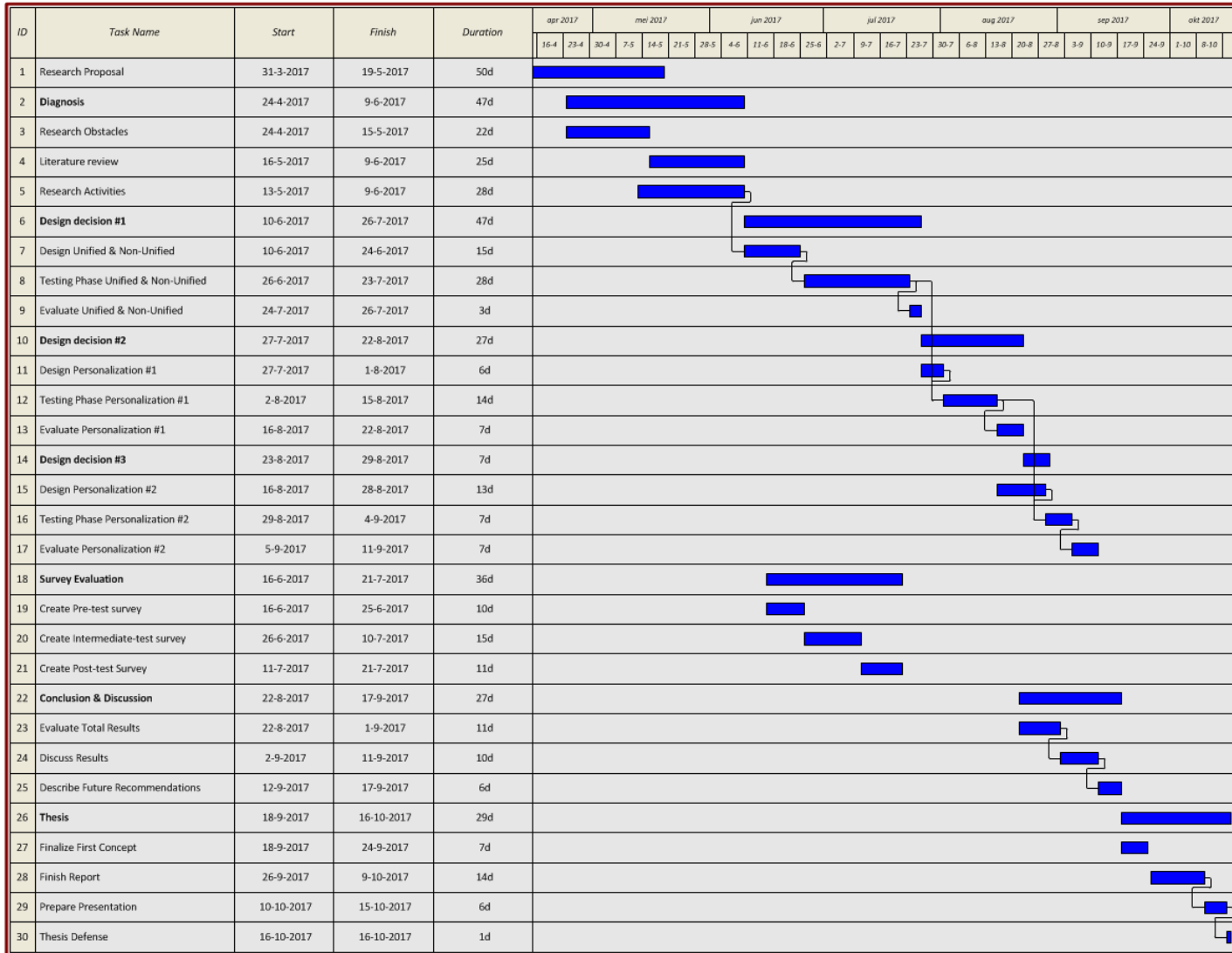


Figure 31. Planning master thesis project.

Appendix H. Screenshots GameBus for design space definition.



Figure 32. Process GameBus challenge design.

**Appendix I. Decision table activities based on HKT**

*Table 33. Activities per risk factor.*

| <b>Risk factor</b>           | <b>Activity 1</b>  | <b>Activity 2</b>   |
|------------------------------|--|---|
| <b>Influenceability</b>      | Use Ecogram app  | Use Minddistrict module: ‘Basiszorg sociale vaardigheden: Nee zeggen’                       |
| <b>Problem understanding</b> | Fill in the HKT-app  | Use Minddistrict module: ‘Je problemen in kaart’  |
| <b>Psychoses</b>             | Use Temstem app  | Use Minddistrict module: ‘Voorlichting psychotische stoornissen’                            |
| <b>Addiction</b>             | Lieberman training: ‘Omgaan met verslaving’                        | Use Minddistrict module: ‘Verslaving’   |
| <b>Impulsiveness</b>         | PMT training   | Use Minddistrict module: ‘Ik wil denken voordat ik doe’                                     |
| <b>Antisocial behavior</b>   | Use Minddistrict module: ‘Basiszorg sociale vaardigheden: Kritiek’ | Use Minddistrict module: ‘Basiszorg sociale vaardigheden: Omgaan met gevoelens van anderen’ |
| <b>Hostility</b>             | Use Mindfulness app  | Participate in sports   |
| <b>Social behavior</b>       | Social skills training (SOVA)                                      | Start a conversation in Minddistrict  |
| <b>Self-reliance</b>         | Clean up your room   | Visit the eHealth center  |
| <b>Treatment readiness</b>   | Comply to your medication planning for 1 week                      | Use Minddistrict module: ‘Forensisch: Zinvol leven: Waar wil ik naartoe?’                   |
| <b>Responsibility</b>        | Follow therapy   | Comply to your weekly treatment schedule  |
| <b>Coping skills</b>         | Follow a training/education  | Use Minddistrict diary: drugs/alcohol   |
| <b>Appointments</b>          | Fill in your agenda on your iPad                                   | Comply to your weekly treatment schedule  |
| <b>Labor skills</b>          | Participate in labor   | Start a conversation regarding your labor possibilities                                     |



## Appendix J. Decision table activities for GameBus challenge

Table 34. Decision table activities for GameBus challenge.

| Activiteit<br>Risicofactor | Dekking door<br>keuze | Deelnam<br>e Arbeid | Minddistri<br>ct Gebruik | Liberma<br>n<br>Training:<br>verslavin<br>g | PMT<br>Trainin<br>g | Ecogra<br>m<br>Invulle<br>n | Agenda<br>Invulle<br>n<br>Tablet | Program<br>ma<br>Navolgen | Therapi<br>e | Trainin<br>g | Scholin<br>g | Medicati<br>e<br>Inneme<br>n | Kamer<br>Opruime<br>n | Bezoek<br>eHealth<br>Centru<br>m | Temste<br>m<br>Gebruik | Spor<br>t | Mindfulne<br>ss App | SOV<br>A | HKT-<br>app |
|----------------------------|-----------------------|---------------------|--------------------------|---|---------------------|-----------------------------|----------------------------------|---------------------------|--------------|--------------|--------------|------------------------------|-----------------------|----------------------------------|------------------------|-----------|---------------------|----------|-------------|
| Beïnvloedbaarheid          | X                     |                     | X                        | X   |                     | X                           |                                  |                           |              |              |              |                              |                       |                                  |                        |           |                     |          | X           |
| Probleeminzicht            | X                     |                     | X                        |   | X                   |                             | X                                | X                         |              | X            |              |                              |                       |                                  |                        |           |                     |          | X           |
| Psychose                   | X                     |                     | X                        |   |                     |                             |                                  |                           |              |              |              |                              |                       |                                  | X                      |           |                     |          | X           |
| Verslaving                 | X                     |                     | X                        | X   |                     |                             |                                  |                           |              | X            | X            |                              |                       |                                  |                        | X         |                     |          | X           |
| Impulsiviteit              | X                     |                     | X                        |   | X                   |                             |                                  |                           |              | X            |              |                              |                       |                                  |                        |           |                     |          | X           |
| Anti-sociaal gedrag        | X                     |                     | X                        |   |                     |                             |                                  |                           | X            |              |              |                              |                       |                                  |                        |           |                     | X        | X           |
| Vijandigheid               | X                     |                     | X                        |   |                     |                             |                                  |                           | X            |              | X            |                              |                       |                                  |                        |           | X                   |          | X           |
| Sociaal Gedrag             | X                     | X                   | X                        |   |                     |                             |                                  |                           |              |              | X            |                              |                       | X                                |                        | X         |                     | X        | X           |
| Zelfredzaamheid            | X                     | X                   | X                        |   | X                   |                             | X                                | X                         |              |              | X            |                              | X                     | X                                |                        |           |                     |          | X           |
| Behandelbereidheid         | X                     |                     | X                        |   |                     |                             | X                                | X                         | X            |              |              | X                            |                       |                                  |                        |           |                     |          | X           |
| Verantwoordelijkheid       | X                     | X                   | X                        |   |                     |                             | X                                | X                         | X            |              | X            | X                            | X                     |                                  |                        |           |                     |          | X           |
| Copingvaardigheden         | X                     |                     | X                        |   | X                   |                             |                                  |                           | X            | X            |              |                              |                       |                                  |                        | X         | X                   |          | X           |
| Afspraken                  | X                     | X                   |                          |   |                     |                             | X                                | X                         |              |              | X            | X                            | X                     |                                  |                        |           |                     |          | X           |
| Arbeidsvaardigheden        | X                     | X                   |                          |   |                     |                             |                                  |                           |              | X            |              |                              |                       |                                  |                        |           |                     |          | X           |
| Dekking                    | 13/14                 | 5/14                | 12/14                    | 2/14  | 4/14                | 1/14                        | 5/14                             | 5/14                      | 8/14         | 5/14         | 5/14         | 4/14                         | 3/14                  | 2/14                             | 1/14                   | 5/14      | 2/14                | 2/14     | 14/14       |
| % Dekking                  | 86%                   | 36%                 | 86%                      | 14%   | 29%                 | 7%                          | 36%                              | 36%                       | 57%          | 36%          | 36%          | 29%                          | 21%                   | 14%                              | 7%                     | 36%       | 14%                 | 14%      | 100%        |

## Appendix K. Visual representation smart scoring systems

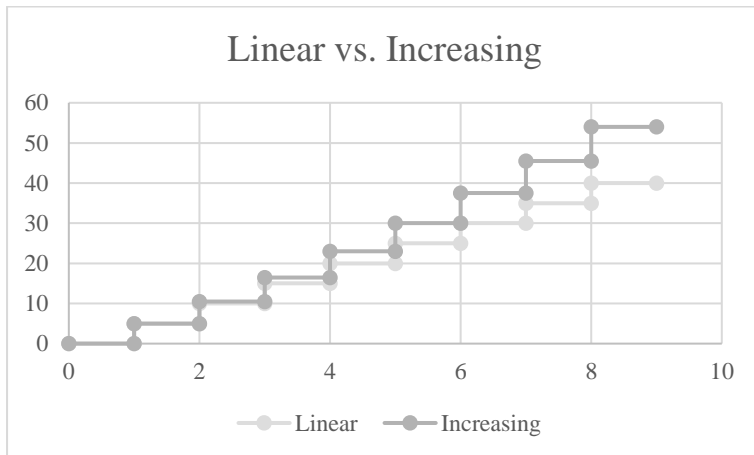


Figure 33. Visual representation increasing scoring system.

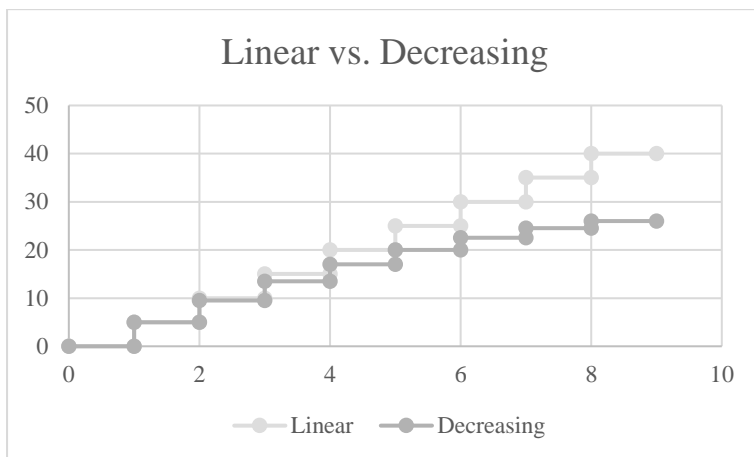


Figure 34. Visual representation decreasing scoring system.

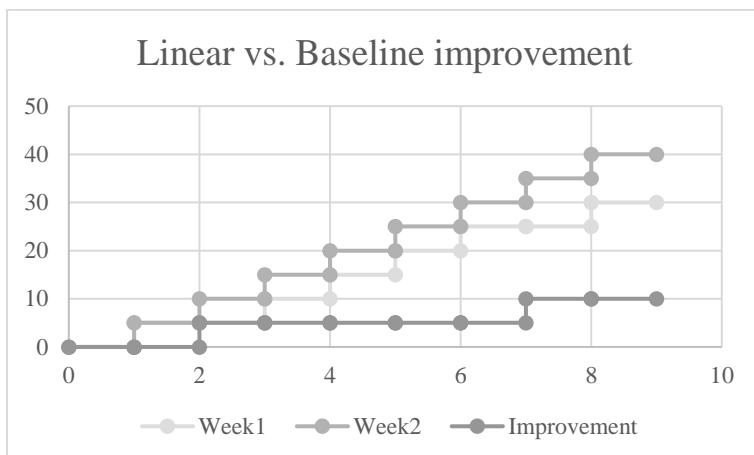


Figure 35. Visual representation baseline improvement scoring system.

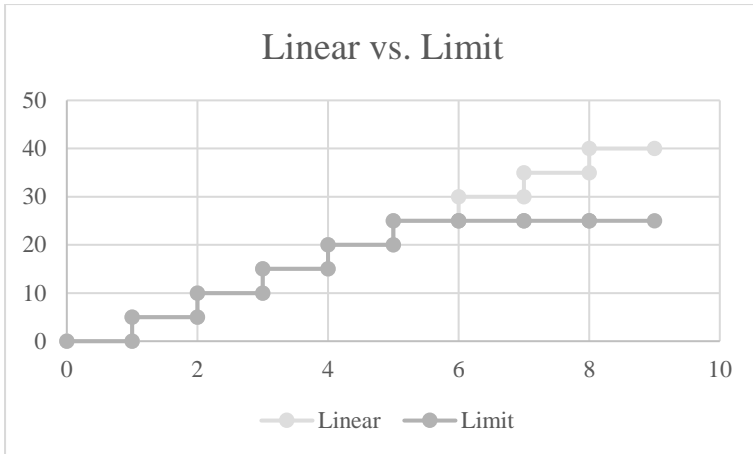


Figure 36. Visual representation limit scoring system.

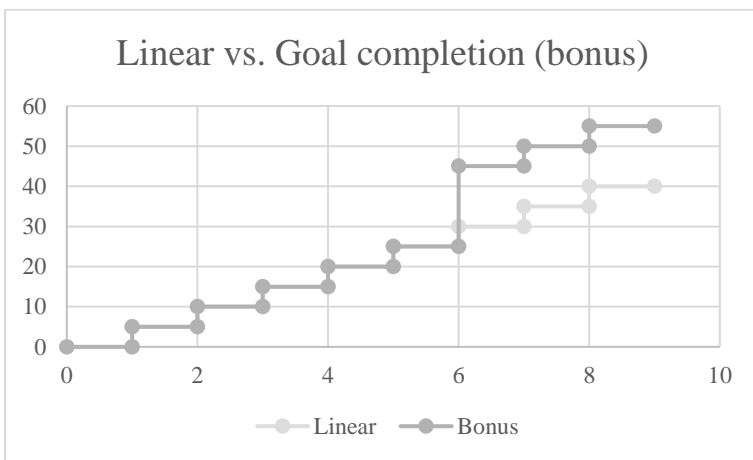


Figure 37. Visual representation goal completion scoring system.

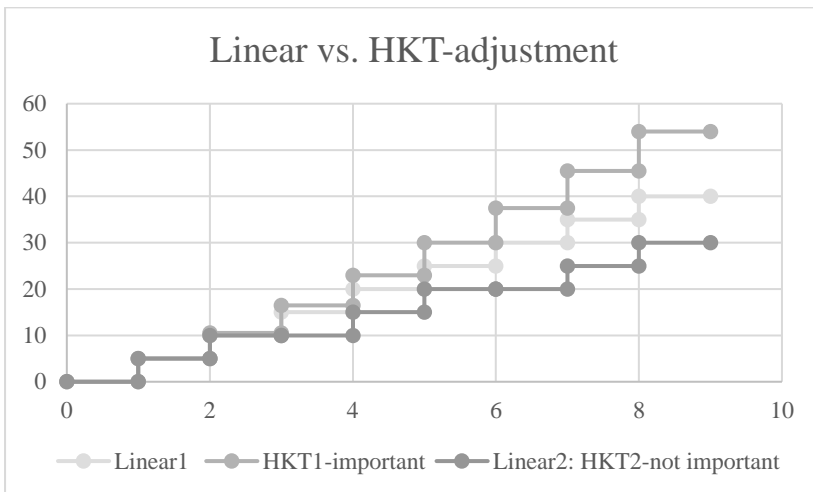


Figure 38. Visual representation HKT-adjustment scoring system.

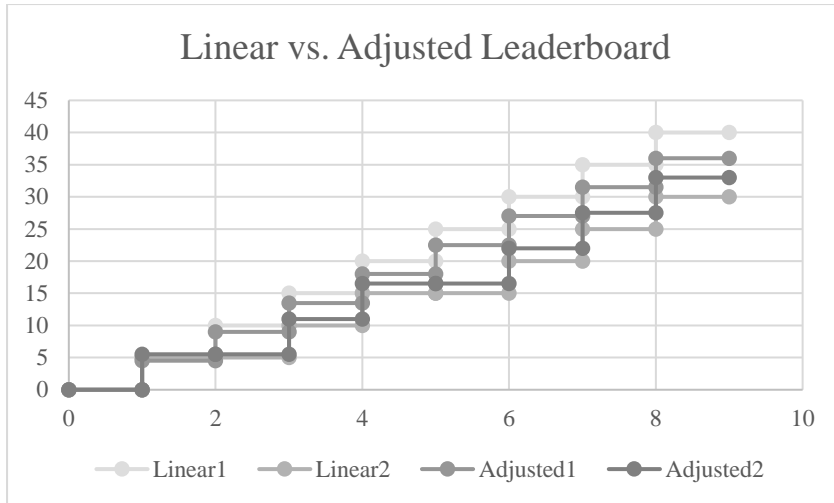


Figure 39. Visual representation adjusted leaderboard scoring system.

## Appendix L. Template decision table

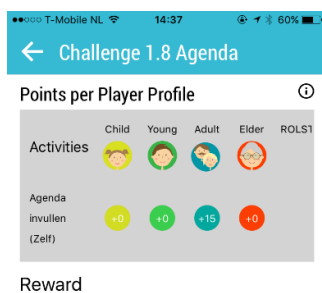
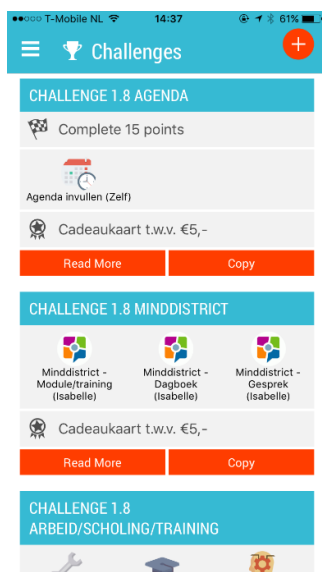
Table 35. Template decision table for best design.

| <b>Requirement and importance weight</b> | <b>Non-unified design</b> | <b>Unified design</b> | <b>First Personalization</b> |
|--|---------------------------|-----------------------|------------------------------|
| <b>Relatedness (2)</b>                   |                           |                       |                              |
| <b>Autonomy (2)</b>                      |                           |                       |                              |
| <b>Competence (2)</b>                    |                           |                       |                              |
| <b>Treatment Awareness (2)</b>           |                           |                       |                              |
| <b>Motivation (3)</b>                    |                           |                       |                              |
| <b>Fun (3)</b>                           |                           |                       |                              |
| <b>Fairness (3)</b>                      |                           |                       |                              |
| <b>Overview (1)</b>                      |                           |                       |                              |
| <b>Total score</b>                       |                           |                       |                              |

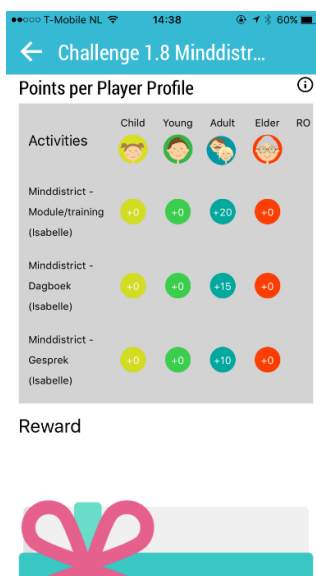
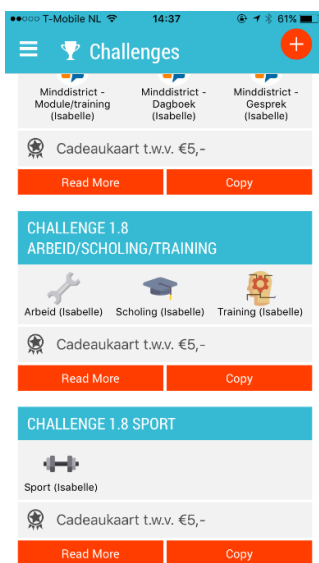
## Appendix M. Screenshots GameBus challenges

### Screenshots non-unified challenge in GameBus

#### Challenge descriptions



Reward



← Challenge 1.8 Arbeid/Sc...

Door mee te doen aan deze wedstrijd maak je kans op verschillende cadeaubonnen en werk je tegelijkertijd aan je risicofactoren binnen De Woenselse Poort. Op een leuke manier kan je je mede cliënten uitdagen de competitie aan te gaan om zo veel mogelijk punten te scoren en hoog op het scorebord te eindigen! Iedereen heeft de kans om te winnen. Deze wedstrijd is gericht op deelname aan arbeid, scholing en training en de punten zullen geregistreerd worden door mij. Je hoeft zelf dus niks voor deze opdracht te doen! Iedere twee weken zal de winnaar persoonlijk zijn prijs overhandigd krijgen.

**Deadline: 2017-07-12**

To join this challenge your team must meet the requirements listed below:  
 Minimum team size: 1  
 Maximum team size: 1


Created by DWP

← Challenge 1.8 Arbeid/Sc...

Points per Player Profile ⓘ

| Activities          | Child | Young | Adult | Elder | ROLST |
|---------------------|-------|-------|-------|-------|-------|
| Arbeid (Isabelle)   | +0    | +0    | +5    | +0    |       |
| Scholing (Isabelle) | +0    | +0    | +5    | +0    |       |
| Training (Isabelle) | +0    | +0    | +5    | +0    |       |

Reward



← Challenge 1.8 Sport

Door mee te doen aan deze wedstrijd maak je kans op verschillende cadeaubonnen en werk je tegelijkertijd aan je risicofactoren binnen De Woenselse Poort. Op een leuke manier kan je je mede cliënten uitdagen de competitie aan te gaan om zo veel mogelijk punten te scoren en hoog op het scorebord te eindigen! Iedereen heeft de kans om te winnen. Deze wedstrijd is gericht op deelname en sport en de punten zullen geregistreerd worden door mij. Je hoeft zelf dus niks voor deze opdracht te doen! Iedere twee weken zal de winnaar persoonlijk zijn prijs overhandigd krijgen.

**Deadline: 2017-07-12**

To join this challenge your team must meet the requirements listed below:  
 Minimum team size: 1  
 Maximum team size: 1

Created by DWP


Subscribe

← Challenge 1.8 Sport

Points per Player Profile ⓘ

| Activities       | Child | Young | Adult | Elder | ROLST |
|------------------|-------|-------|-------|-------|-------|
| Sport (Isabelle) | +0    | +0    | +5    | +0    |       |

Reward



# Final leaderboards

Challenges +

**CHALLENGE 1.8 AGENDA** 3 hours left

Created by DWP

|    |                       |    |
|----|-----------------------|----|
| 1  | Arni Sanchez's circle | 30 |
| 2  | Ismael Abdi's circle  | 30 |
| 3  | Isabelle v...         | 15 |
| 4  | Jean Paul...          | 15 |
| 5  | murat tu...           | 0  |
| 6  | Christian...          | 0  |
| 7  | Abdullah ...          | 0  |
| 8  | DWP Test...           | 0  |
| 9  | Pieter Va...          | 0  |
| 10 | Marco St...           | 0  |

Cadeaukaart t.w.v. €5,- by DWP

[Read More](#) [Claim Points!](#)

Challenges +

**CHALLENGE 1.8 MINDDISTRICT** 3 hours left

Created by DWP

|    |                           |    |
|----|---------------------------|----|
| 1  | Jean Paul Heller's cir... | 60 |
| 2  | Marco St...               | 20 |
| 3  | Isabelle v...             | 0  |
| 4  | murat tu...               | 0  |
| 5  | Christian...              | 0  |
| 6  | Abdullah ...              | 0  |
| 7  | DWP Test...               | 0  |
| 8  | Pieter Va...              | 0  |
| 9  | Arni Sanc...              | 0  |
| 10 | Ismael Ab...              | 0  |

Cadeaukaart t.w.v. €5,- by DWP

[Read More](#) [Claim Points!](#)

Challenges +

**CHALLENGE 1.8 ARBEID/SCHOLING/TRAINING** 3 hours left

Created by DWP

|    |                           |     |
|----|---------------------------|-----|
| 1  | Jean Paul Heller's cir... | 175 |
| 2  | Arni Sanchez...           | 115 |
| 3  | murat tu...               | 60  |
| 4  | Isabelle v...             | 55  |
| 5  | Christian...              | 55  |
| 6  | Abdullah ...              | 55  |
| 7  | Ismael Ab...              | 45  |
| 8  | Marco St...               | 30  |
| 9  | DWP Test...               | 0   |
| 10 | Pieter Va...              | 0   |

Cadeaukaart t.w.v. €5,- by DWP

[Read More](#) [Claim Points!](#)

Challenges +

**CHALLENGE 1.8 SPORT** 3 hours left

Created by DWP

|    |                           |    |
|----|---------------------------|----|
| 1  | Jean Paul Heller's cir... | 50 |
| 2  | Marco Steenhuis's cir...  | 50 |
| 3  | Ismael Abdi ...           | 30 |
| 4  | Arni Sanc...              | 20 |
| 5  | Abdullah ...              | 10 |
| 6  | murat tu...               | 5  |
| 7  | Isabelle v...             | 0  |
| 8  | Christian...              | 0  |
| 9  | DWP Test...               | 0  |
| 10 | Pieter Va...              | 0  |

Cadeaukaart t.w.v. €5,- by DWP

[Read More](#) [Claim Points!](#)



## Screenshots unified challenge in GameBus

### Challenge descriptions

← Challenge 2.8

Door mee te doen aan deze wedstrijd maak je kans op een cadeaubon en werk je tegelijkertijd aan je risicofactoren binnen De Woenselse Poort. Op een leuke manier kan je je mede cliënten uitdagen de competitie aan te gaan om zo veel mogelijk punten te scoren en hoog op het scorebord te eindigen! Iedereen heeft de kans om te winnen. Dit keer zal de wedstrijd alle mogelijke activiteiten meenemen in 1 grote wedstrijd en dus kunnen er punten gescoord worden voor Minddistrict gebruik, deelname aan sport, deelname aan arbeid, scholing, training en therapie en voor het invullen van je agenda op je iPad. Ik registreer de punten voor je op die van de agenda activiteit na. Iedere twee weken zal de winnaar persoonlijk zijn prijs overhandigd krijgen.

**Deadline: 2017-07-26**

To join this challenge your team must meet the requirements listed below:  
 Minimum team size: 1  
 Maximum team size: 1

← Challenge 2.8

Created by DWP

Subscribe

Points per Player Profile

| Activities                                | Child | Young | Adult | Elder |
|---|-------|-------|-------|-------|
| Minddistrict - Module/training (Isabelle) | +0    | +0    | +20   | +0    |
| Minddistrict - Dagboek (Isabelle)         | +0    | +0    | +15   | +0    |
| Minddistrict - Gesprek (Isabelle)         | +0    | +0    | +10   | +0    |
| Sport (Isabelle)                          | +0    | +0    | +5    | +0    |
| Agenda invullen (Zelf)                    | +0    | +0    | +15   | +0    |

← Challenge 2.8

|                              |    |    |     |    |
|------------------------------|----|----|-----|----|
| Agenda invullen (Zelf)       | +0 | +0 | +15 | +0 |
| Arbeid (Isabelle)            | +0 | +0 | +5  | +0 |
| Scholing (Isabelle)          | +0 | +0 | +5  | +0 |
| Training/therapie (Isabelle) | +0 | +0 | +5  | +0 |

Reward

### Final leaderboard

Challenges

Active Upcoming Completed

CHALLENGE 2.8 8 hours left

Created by DWP

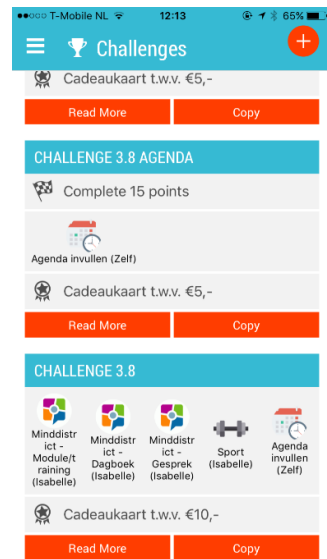
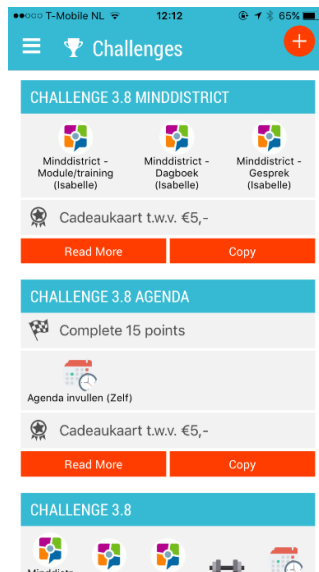
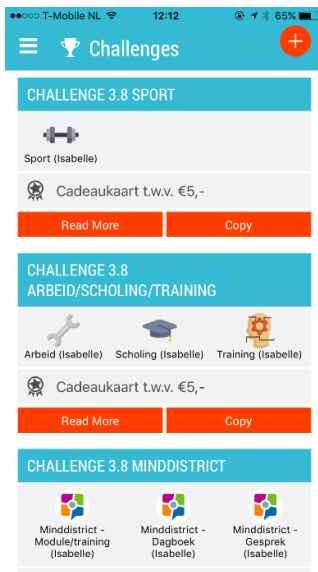
|    |                           |                           |
|----|---------------------------|---------------------------|
| 1  | Jean Paul Heller's cir... | 390                       |
| 2  | Arni Sanc...              | 140                       |
| 3  | Ismael Ab...              | 135                       |
| 4  | Marco St...               | 105                       |
| 5  | murat tu...               | 70                        |
| 6  | Abdullah ...              | 55                        |
| 7  | Christian...              | 10                        |
| 8  | DWP Test...               | 0                         |
| 9  | Isabelle v...             | 0 <span>390 to go!</span> |
| 10 | Pieter Va...              | 0                         |

Cadeaukaart L.w.v. €20,- by DWP

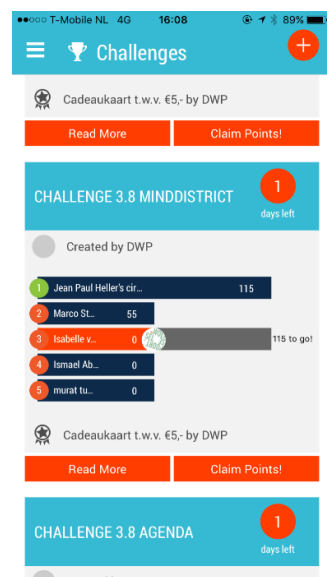
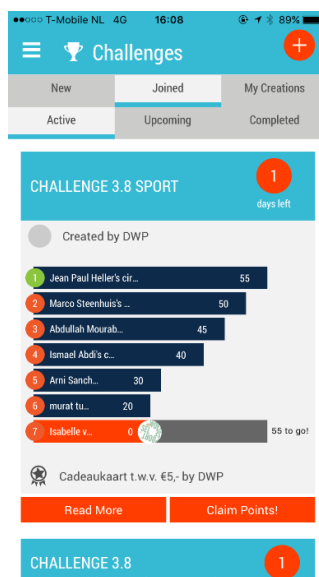
Read More Claim Points!

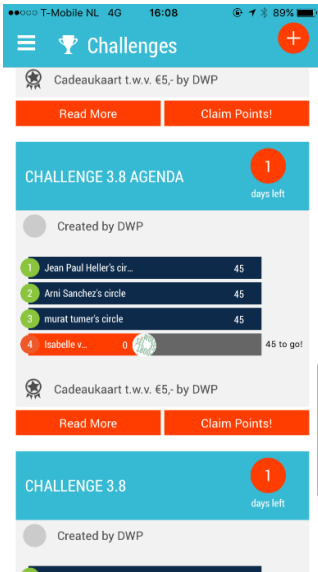
## Screenshots personalized design

### Challenge descriptions



### Leaderboards





## Appendix N. Reliability of scales and normality test

Table 36. Cronbach's alpha values.

| Scales                                | Cronbach's alpha | N of items |
|---------------------------------------|------------------|------------|
| Relatedness – Pre-test                | .889             | 3          |
| Relatedness – Post-test               | .896             | 3          |
| Competence – Pre-test                 | .810             | 4          |
| Competence – Post-test                | .718             | 4          |
| Autonomy – Pre-test                   | .856             | 4          |
| Autonomy – Post-test                  | .764             | 4          |
| Intrinsic motivation – Pre-test       | .897             | 4          |
| Intrinsic motivation – Post-test      | .829             | 4          |
| Identified regulation – Pre-test      | .787             | 4          |
| Identified regulation – Post-test     | .872             | 4          |
| Interest/enjoyment – Non-personalized | .833             | 7          |
| Interest/enjoyment – Personalized     | .932             | 7          |
| Fairness – Non-personalized           | .953             | 4          |
| Fairness – Personalized               | .715             | 4          |

Table 37. Shapiro-Wilk test values.

| Scale                 | Shapiro-Wilk Test |    |      |
|-----------------------|-------------------|----|------|
|                       | Statistic         | df | Sig. |
| Relatedness           | .701              | 6  | .006 |
| Competence            | .823              | 6  | .093 |
| Autonomy              | .913              | 6  | .456 |
| Intrinsic motivation  | .861              | 6  | .191 |
| Identified regulation | .861              | 6  | .212 |
| Interest/enjoyment    | .908              | 6  | .421 |
| Fairness              | .845              | 6  | .143 |

## Appendix O. Results paired t-tests

### Self-Determination Theory (No GameBus usage versus GameBus usage)

Table 38. Paired Samples Statistics for 'SDT'.

|                         | Mean  | N | Std. Deviation | Std. Error Mean |
|-------------------------|-------|---|----------------|-----------------|
| Relatedness – Pre-test  | 3.833 | 6 | .547           | .224            |
| Relatedness – Post-test | 3.667 | 6 | .730           | .298            |
| Competence – Pre-test   | 3.500 | 6 | .592           | .241            |
| Competence – Post-test  | 4.083 | 6 | .465           | .190            |
| Autonomy – Pre-test     | 3.083 | 6 | .785           | .321            |
| Autonomy – Post-test    | 3.583 | 6 | .584           | .239            |

Table 39. Paired Samples Test for 'SDT'.

|             | Mean  | s    | SEM  | 95% CI |       | t      | df | Sig. |
|-------------|-------|------|------|--------|-------|--------|----|------|
|             |       |      |      | Lower  | Upper |        |    |      |
| Relatedness | -.167 | .279 | .114 | -.459  | .126  | -1.464 | 5  | .203 |
| Competence  | .583  | .342 | .139 | .225   | .942  | 4.183  | 5  | .009 |
| Autonomy    | .500  | .387 | .158 | .094   | .906  | 3.163  | 5  | .025 |

### Motivation (No GameBus usage versus GameBus usage)

Table 40. Paired Samples Statistics for 'Motivation'.

|                                   | Mean  | N | Std. Deviation | Std. Error Mean |
|-----------------------------------|-------|---|----------------|-----------------|
| Intrinsic motivation – Pre-test   | 2.958 | 6 | .485           | .198            |
| Intrinsic motivation – Post-test  | 3.583 | 6 | .585           | .237            |
| Identified regulation – Pre-test  | 3.625 | 6 | .468           | .191            |
| Identified regulation – Post-test | 3.917 | 6 | .465           | .190            |

Table 41. Paired Samples Test for 'Motivation'.

|                       | Mean | s    | SEM  | 95% CI |       | t     | df | Sig. |
|-----------------------|------|------|------|--------|-------|-------|----|------|
|                       |      |      |      | Lower  | Upper |       |    |      |
| Intrinsic motivation  | .625 | .345 | .141 | .263   | .987  | 4.443 | 5  | .007 |
| Identified regulation | .292 | .188 | .077 | .094   | .489  | 3.796 | 5  | .013 |

### Fun (Non-personalized versus Personalized)

Table 42. Paired Samples Statistics for 'Fun'.

|                                       | Mean  | N | Std. Deviation | Std. Error Mean |
|---------------------------------------|-------|---|----------------|-----------------|
| Interest/enjoyment – Non-Personalized | 3.476 | 6 | .390           | .159            |
| Interest/enjoyment – Personalized     | 4.000 | 6 | .688           | .281            |

Table 43. Paired Samples Test for 'Fun'.

|                    | Mean | s    | SEM  | 95% CI |       | t     | df | Sig. |
|--------------------|------|------|------|--------|-------|-------|----|------|
|                    |      |      |      | Lower  | Upper |       |    |      |
| Interest/enjoyment | .524 | .334 | .136 | .173   | .874  | 3.841 | 5  | .012 |

**Fairness (Non-personalized versus Personalized)**

Table 44. Paired Samples Statistics for 'Fairness'.

|                             | Mean  | N | Std. Deviation | Std. Error Mean |
|-----------------------------|-------|---|----------------|-----------------|
| Fairness – Non-Personalized | 3.250 | 6 | .975           | .398            |
| Fairness– Personalized      | 4.000 | 6 | .316           | .129            |

Table 45. Paired Samples Test for 'Fairness'.

|          | Mean | s    | SEM  | 95% CI |       | t     | df | Sig. |
|----------|------|------|------|--------|-------|-------|----|------|
|          |      |      |      | Lower  | Upper |       |    |      |
| Fairness | .750 | .806 | .329 | -.096  | 1.596 | 2.279 | 5  | .072 |

## Appendix P. Coding scheme of interviews

Table 46. Nodes overview with references from interview.

| Name                       | References |
|----------------------------|------------|
| <b>Designs</b>             | 60         |
| Non-unified                | 23         |
| Fairness                   | 6          |
| Fits personal program      | 0          |
| Overview                   | 6          |
| Prefers non-unified        | 11         |
| Excel at one point         | 3          |
| Non-unified and unified    | 4          |
| Prefers combi              | 4          |
| Personalized design        | 28         |
| Fairness                   | 3          |
| Fits personal program      | 9          |
| Overview                   | 0          |
| Prefers personalized       | 12         |
| Unified                    | 5          |
| Fairness                   | 1          |
| Fits personal program      | 0          |
| Overview                   | 1          |
| Prefers unified            | 2          |
| <b>Experiences</b>         | 158        |
| General                    | 84         |
| Negative                   | 19         |
| Boring                     | 1          |
| Negative                   | 6          |
| Unfair                     | 7          |
| Degree of control          | 3          |
| Useless                    | 5          |
| Positive                   | 65         |
| Fair                       | 3          |
| Equal opportunity to win   | 0          |
| Fun                        | 5          |
| Helpful                    | 4          |
| Motivating                 | 18         |
| To do things               | 10         |
| To meet appointments       | 5          |
| Positive                   | 18         |
| Positive in general        | 6          |
| Provide insights           | 11         |
| Non-unified                | 29         |
| Negative                   | 10         |
| Positive                   | 19         |
| Personalized               | 24         |
| Negative                   | 6          |
| Positive                   | 18         |
| Unified                    | 21         |
| Negative                   | 12         |
| Positive                   | 9          |
| <b>Future improvements</b> | 64         |
| Activities                 | 25         |
| Appearance                 | 4          |

---

|                          |    |
|--------------------------|----|
| Groups                   | 21 |
| Buddy                    | 2  |
| Departments              | 10 |
| Involve therapist        | 6  |
| Points                   | 8  |
| Set own goals            | 5  |
| <b>Player type</b>       | 12 |
| Disruptor                | 1  |
| Extrinsic                | 4  |
| Intrinsic                | 7  |
| <b>SDT en Motivation</b> | 33 |
| Autonomy                 | 7  |
| Competence               | 9  |
| Motivation               | 13 |
| Extrinsic                | 7  |
| Intrinsic                | 5  |
| Relatedness              | 4  |

---



## Appendix Q. Personas creation

Table 47. Characteristics pilot participants.

|                        | ID 5        | ID 2      | ID 6        | ID 4        | ID 1            | ID 3            | ID 7        |
|------------------------|-------------|-----------|-------------|-------------|-----------------|-----------------|-------------|
| <b>Competitiveness</b> | High        | Low       | M L         | H M         | Low             | Low             | Medium      |
| <b>Motivation</b>      | High        | High      | Medium      | Medium      | Low             | Low             | H M         |
| <b>Effort</b>          | Low         | High      | Medium      | Medium      | Medium          | Medium          | Medium      |
| <b>Interest</b>        | High        | Medium    | Medium      | Medium      | Low             | Low             | High        |
| <b>Department</b>      | Woensel     | Woensel   | Poort       | Poort       | Poort           | Poort           | Poort       |
| <b>Stage</b>           | Treatment   | Treatment | T R         | T R         | Resocialization | Resocialization | T R         |
| <b>Care path</b>       | Personality | Psychosis | Personality | Personality | Personality     | Personality     | Personality |
| <b>Full program</b>    | Full        | Medium    | Medium      | Medium      | Low             | Low             | Medium      |
| <b>Challenges</b>      | 4           | 3         | 3           | 2           | 2               | 1               | 3           |

**Appendix R. Developed personas for evaluation of scoring systems.**



Figure 40. Personas based on pilot.

## Appendix S. Post-test smart scoring systems for employees

### Score systemen voor GameBus wedstrijden

#### Uitleg onderzoek

Mijn onderzoek focust zich op het ontwikkelen van een wedstrijd die de cliënten binnen DWP kan motiveren om hun afspraken na te komen en zo hun behandelprogramma succesvol te volgen. Daarnaast kan de wedstrijd de medewerkers de mogelijkheid bieden om te kijken hoe goed een bepaalde cliënt het doet en kan het zo ook een monitorende functie hebben. Dit alles wordt ontwikkeld in de app 'GameBus'. Een app waarbij activiteiten gekozen kunnen worden die gescoord kunnen worden met punten. Deze punten komen vervolgens op een scoreboard waarbij een overzicht wordt gecreëerd van het totaal behaalde punten van een specifieke cliënt. Dit scoreboard komt er als volgt uit te zien:



Op dit moment ben ik bezig met het ontwikkelen van een hulptool die het maken van een gepersonaliseerde wedstrijd moet ondersteunen. Hierbij is de eerste stap het kiezen van de juiste activiteiten. De tweede stap is het kiezen van het juiste puntensysteem. Ik wil graag jullie feedback vragen over de soorten puntensystemen waarbij ik graag zou willen achterhalen wat wel en geen goede systemen zijn, voor welke soorten cliënten en voor welke activiteiten. De soorten systemen zullen nu kort uitgelegd worden, waarbij ik wil vragen of je een cijfer en verder feedback wilt geven voor dat specifieke systeem.

## Lineair

Iedere keer dat een cliënt een activiteit uitvoert krijgt hij/zij even veel punten hiervoor

|   |                                     | Helemaal niet<br>mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee<br>eens |
|---|-------------------------------------|---------------------------|---------------|----------|----------|----------------------|
| 1 | Dit scoringssysteem is zeer passend | 1                         | 2             | 3        | 4        | 5                    |

Waarom wel/niet?

.....  
.....

Indien score 4 of 5, beantwoord alsjeblieft onderstaande vragen:

|   |  |   |   |   |   |   |
|---|--|---|---|---|---|---|
| 1 | Dit scoringssysteem is zeer passend voor alle activiteiten | 1 | 2 | 3 | 4 | 5 |
| 2 | Dit scoringssysteem is passend voor de opname fase         | 1 | 2 | 3 | 4 | 5 |
| 3 | Dit scoringssysteem is passend voor de behandel fase       | 1 | 2 | 3 | 4 | 5 |
| 4 | Dit scoringssysteem is passend voor de resocialisatie fase | 1 | 2 | 3 | 4 | 5 |
| 5 | Dit scoringssysteem is zeer passend voor alle cliënten     | 1 | 2 | 3 | 4 | 5 |

Als vraag 1 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....  
.....

Niet:

.....  
.....

Als vraag 5 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....  
.....

Niet:

.....  
.....

## Stijgend

Iedere keer dat een cliënt een activiteit uitvoert krijgt hij/zij hier steeds meer punten voor

|   |                                     | Helemaal niet<br>mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee<br>eens |
|---|-------------------------------------|---------------------------|---------------|----------|----------|----------------------|
| 1 | Dit scoringssysteem is zeer passend | 1                         | 2             | 3        | 4        | 5                    |

Waarom wel/niet?

.....

.....

Indien score 4 of 5, beantwoord alsjeblieft onderstaande vragen:

|   |  |   |   |   |   |   |
|---|--|---|---|---|---|---|
| 1 | Dit scoringssysteem is zeer passend voor alle activiteiten | 1 | 2 | 3 | 4 | 5 |
| 2 | Dit scoringssysteem is passend voor de opname fase         | 1 | 2 | 3 | 4 | 5 |
| 3 | Dit scoringssysteem is passend voor de behandel fase       | 1 | 2 | 3 | 4 | 5 |
| 4 | Dit scoringssysteem is passend voor de resocialisatie fase | 1 | 2 | 3 | 4 | 5 |
| 5 | Dit scoringssysteem is zeer passend voor alle cliënten     | 1 | 2 | 3 | 4 | 5 |

Als vraag 1 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....

.....

Niet:

.....

.....

Als vraag 5 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....

.....

Niet:

.....

.....

## Dalend

Iedere keer dat een cliënt een activiteit uitvoert krijgt hij/zij hier steeds minder punten voor

|   |                                     | Helemaal niet<br>mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee<br>eens |
|---|-------------------------------------|---------------------------|---------------|----------|----------|----------------------|
| 1 | Dit scoringssysteem is zeer passend | 1                         | 2             | 3        | 4        | 5                    |

Waarom wel/niet?

.....  
.....

Indien score 4 of 5, beantwoord alsjeblieft onderstaande vragen:

|   |  |   |   |   |   |   |
|---|--|---|---|---|---|---|
| 1 | Dit scoringssysteem is zeer passend voor alle activiteiten | 1 | 2 | 3 | 4 | 5 |
| 2 | Dit scoringssysteem is passend voor de opname fase         | 1 | 2 | 3 | 4 | 5 |
| 3 | Dit scoringssysteem is passend voor de behandel fase       | 1 | 2 | 3 | 4 | 5 |
| 4 | Dit scoringssysteem is passend voor de resocialisatie fase | 1 | 2 | 3 | 4 | 5 |
| 5 | Dit scoringssysteem is zeer passend voor alle cliënten     | 1 | 2 | 3 | 4 | 5 |

Als vraag 1 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....  
.....

Niet:

.....  
.....

Als vraag 5 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....  
.....

Niet:

.....  
.....

## Baseline verbetering

Cliënten moeten zich verbeteren ten opzichte van vorige week/maand om punten te krijgen

|   |                                     | Helemaal niet<br>mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee<br>eens |
|---|-------------------------------------|---------------------------|---------------|----------|----------|----------------------|
| 1 | Dit scoringssysteem is zeer passend | 1                         | 2             | 3        | 4        | 5                    |

Waarom wel/niet?

.....

.....

Indien score 4 of 5, beantwoord alsjeblieft onderstaande vragen:

|   |  |   |   |   |   |   |
|---|--|---|---|---|---|---|
| 1 | Dit scoringssysteem is zeer passend voor alle activiteiten | 1 | 2 | 3 | 4 | 5 |
| 2 | Dit scoringssysteem is passend voor de opname fase         | 1 | 2 | 3 | 4 | 5 |
| 3 | Dit scoringssysteem is passend voor de behandel fase       | 1 | 2 | 3 | 4 | 5 |
| 4 | Dit scoringssysteem is passend voor de resocialisatie fase | 1 | 2 | 3 | 4 | 5 |
| 5 | Dit scoringssysteem is zeer passend voor alle cliënten     | 1 | 2 | 3 | 4 | 5 |

Als vraag 1 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....

.....

Niet:

.....

.....

Als vraag 5 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....

.....

Niet:

.....

.....

**Limiet op dag/week basis**

Er kan maar een maximaal aantal punten worden gescoord voor een specifieke activiteit per dag/week

|   |                                     | Helemaal niet<br>mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee<br>eens |
|---|-------------------------------------|---------------------------|---------------|----------|----------|----------------------|
| 1 | Dit scoringssysteem is zeer passend | 1                         | 2             | 3        | 4        | 5                    |

Waarom wel/niet?

.....

.....

Indien score 4 of 5, beantwoord alsjeblieft onderstaande vragen:

|   |  |   |   |   |   |   |
|---|--|---|---|---|---|---|
| 1 | Dit scoringssysteem is zeer passend voor alle activiteiten | 1 | 2 | 3 | 4 | 5 |
| 2 | Dit scoringssysteem is passend voor de opname fase         | 1 | 2 | 3 | 4 | 5 |
| 3 | Dit scoringssysteem is passend voor de behandel fase       | 1 | 2 | 3 | 4 | 5 |
| 4 | Dit scoringssysteem is passend voor de resocialisatie fase | 1 | 2 | 3 | 4 | 5 |
| 5 | Dit scoringssysteem is zeer passend voor alle cliënten     | 1 | 2 | 3 | 4 | 5 |

Als vraag 1 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....

.....

Niet:

.....

.....

Als vraag 5 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....

.....

Niet:

.....

.....

Omcirkel voorkeur: DAG / WEEK / ALLEBEI



### Voltooiing op dag/week basis

Wanneer de cliënt zijn doelen heeft bereikt op dag/week basis krijgt hij/zij bonuspunten toegekend

|   |                                     | Helemaal niet<br>mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee<br>eens |
|---|-------------------------------------|---------------------------|---------------|----------|----------|----------------------|
| 1 | Dit scoringssysteem is zeer passend | 1                         | 2             | 3        | 4        | 5                    |

Waarom wel/niet?

.....  
.....

Indien score 4 of 5, beantwoord alsjeblieft onderstaande vragen:

|   |  |   |   |   |   |   |
|---|--|---|---|---|---|---|
| 1 | Dit scoringssysteem is zeer passend voor alle activiteiten | 1 | 2 | 3 | 4 | 5 |
| 2 | Dit scoringssysteem is passend voor de opname fase         | 1 | 2 | 3 | 4 | 5 |
| 3 | Dit scoringssysteem is passend voor de behandel fase       | 1 | 2 | 3 | 4 | 5 |
| 4 | Dit scoringssysteem is passend voor de resocialisatie fase | 1 | 2 | 3 | 4 | 5 |
| 5 | Dit scoringssysteem is zeer passend voor alle cliënten     | 1 | 2 | 3 | 4 | 5 |

Als vraag 1 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....  
.....

Niet:

.....  
.....

Als vraag 5 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....  
.....

Niet:

.....  
.....

Omcirkel voorkeur: DAG / WEEK / ALLEBEI

**Score op basis van HKT**

Op basis van de grootste risicogebieden krijgt de cliënt extra punten voor activiteiten die hem/haar hierbij helpen

|   |                                     | Helemaal niet mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee eens |
|---|-------------------------------------|------------------------|---------------|----------|----------|-------------------|
| 1 | Dit scoringssysteem is zeer passend | 1                      | 2             | 3        | 4        | 5                 |

Waarom wel/niet?

.....

.....

Indien score 4 of 5, beantwoord alsjeblieft onderstaande vragen:

|   |  |   |   |   |   |   |
|---|--|---|---|---|---|---|
| 1 | Dit scoringssysteem is zeer passend voor alle activiteiten | 1 | 2 | 3 | 4 | 5 |
| 2 | Dit scoringssysteem is passend voor de opname fase         | 1 | 2 | 3 | 4 | 5 |
| 3 | Dit scoringssysteem is passend voor de behandel fase       | 1 | 2 | 3 | 4 | 5 |
| 4 | Dit scoringssysteem is passend voor de resocialisatie fase | 1 | 2 | 3 | 4 | 5 |
| 5 | Dit scoringssysteem is zeer passend voor alle cliënten     | 1 | 2 | 3 | 4 | 5 |

Als vraag 1 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....

.....

Niet:

.....

.....

Als vraag 5 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....

.....

Niet:

.....

.....

## Aanpassing aan vorige leaderboard

Op basis van het leaderboard van vorige week krijgt de cliënt aangepaste punten

|   |                                     | Helemaal niet<br>mee eens | Niet mee eens | Neutraal | Mee eens | Volledig mee<br>eens |
|---|-------------------------------------|---------------------------|---------------|----------|----------|----------------------|
| 1 | Dit scoringssysteem is zeer passend | 1                         | 2             | 3        | 4        | 5                    |

Waarom wel/niet?

.....

.....

Indien score 4 of 5, beantwoord alsjeblieft onderstaande vragen:

|   |  |   |   |   |   |   |
|---|--|---|---|---|---|---|
| 1 | Dit scoringssysteem is zeer passend voor alle activiteiten | 1 | 2 | 3 | 4 | 5 |
| 2 | Dit scoringssysteem is passend voor de opname fase         | 1 | 2 | 3 | 4 | 5 |
| 3 | Dit scoringssysteem is passend voor de behandel fase       | 1 | 2 | 3 | 4 | 5 |
| 4 | Dit scoringssysteem is passend voor de resocialisatie fase | 1 | 2 | 3 | 4 | 5 |
| 5 | Dit scoringssysteem is zeer passend voor alle cliënten     | 1 | 2 | 3 | 4 | 5 |

Als vraag 1 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....

.....

Niet:

.....

.....

Als vraag 5 een score 1 of 2 heeft, geef alsjeblieft aan:

Wel:

.....

.....

Niet:

.....

.....

## Appendix T. Evaluations scoring systems by employees

Table 48. Employee evaluation of scoring systems.

| Scoring system              | Benefits   | Drawbacks  |
|-----------------------------|--|--|
| <b>Linear</b>               | Motivating<br>Simple to understand<br>Simplicity   |  |
| <b>Increasing</b>           | Motivating<br>The hardest thing for most clients is to persist in doing activities they don't like to do , this will stimulate them to perform the activities again  | At the end, the actual points that are received for a specific activity might be out of proportion<br>Not applicable for activities that take little effort<br>Might put too much emphasis on winning  |
| <b>Decreasing</b>           |  | Demotivating<br>The hardest thing for most clients is to persist in doing activities, this will not stimulate this<br>A game should be fun and you should be able to win points  |
| <b>Baseline improvement</b> | Could stimulate clients to keep on improving themselves<br>Might be applicable to activities that ask for short term improvements  | Demotivating when you are at your maximum number of personally achievable activities<br>Could result in the situation where clients are doing less because they know that they will be punished in the next period<br>When a client has a full daily program already they would be punished by this scoring system |
| <b>Daily/weekly limit</b>   | Enough is enough, clients should not always do more of a specific activity<br>Applicable for activities that take little effort and for clients with care path personality<br>Can be fair in the case of big differences between clients in number of activities | Demotivating to perform more than can be scored<br>Not applicable for clients that have to put a lot of effort in their activities   |
| <b>Goal completion</b>      | Motivating<br>In line with GameBus<br>Bonus points have a very positive meaning<br>Provides insights in goals<br>Shows effect of personal effort and goals<br>Provide insights in treatment  | Some clients experience difficulties in thinking ahead. Should have support in knowing how far they are in achieving their goals   |

---

|   |   |  |
|---|---|--|
| <b>HKT-based</b>                          | Motivating<br>Very applicable to DWP<br>Stimulates the usage of the HKT-app<br>Good in providing personal insights<br>More awareness of treatment | Point of attention is what is used as a starting point for this score system: values of employee or of client?   |
| <b>Adjustment to previous leaderboard</b> |   | Punishes person who is performing well, rewards person who might perform intentionally bad<br>Not suitable for this population<br>Demotivating<br>Complicated<br>Too much emphasis on 'winner' and 'loser' |

---

## Appendix U. Overview hospitalization planning

Table 49. Hospitalization planning personality.



|            |        |  <b>Opnameprogramma</b> <b>Woensel</b><br><b>Persoonlijkheid</b> |                              |          |              |         |  |  |
|------------|--------|---|------------------------------|----------|--------------|---------|--|--|
| Bloktijd   |        | Maandag   | Dinsdag                      | Woensdag | Donderdag    | Vrijdag |  |  |
| 0900-1000  | Blok 1 |   |                              |          |              |         |  |  |
| 1020-1120  | Blok 2 |   |                              |          |              |         |  |  |
| 1140- 1240 | Blok 3 | Training  | Therapie**<br>Drama /<br>PMT |          | Scholing     |         |  |  |
| 1330-1430  | Blok 4 |   |                              |          | Dagbesteding |         |  |  |
| 1500-1600  | Blok 5 |   |                              |          |              |         |  |  |

Table 50. Hospitalization planning psychosis.

|            |        |  <b>Opnameprogramma</b> <b>Woensel</b><br><b>Psychose</b> |          |          |                                   |         |  |  |
|------------|--------|--|----------|----------|-----------------------------------|---------|--|--|
| Bloktijd   |        | Maandag  | Dinsdag  | Woensdag | Donderdag                         | Vrijdag |  |  |
| 0900-1000  | Blok 1 | Dagbesteding   |          |          |                                   |         |  |  |
| 1020-1120  | Blok 2 | Scholing   | Training |          | Therapie**<br>Beeldend/<br>Muziek |         |  |  |
| 1140- 1240 | Blok 3 |  |          |          |                                   |         |  |  |
| 1330-1430  | Blok 4 |  |          |          |                                   |         |  |  |
| 1500-1600  | Blok 5 |  |          |          |                                   |         |  |  |

## Appendix V. Weightings activities for HKT-scores

Table 51. Weightings for activities per HKT risk factor.

|                         | Sport      | Therapie  | Training  | Arbeid     | Dagbest. | eHealth  | iPad       | MD        | Scholing   | Opstaan    | Kamer      | Koken      | Financiën | Netwerk  | Vervolg    |
|-------------------------|------------|-----------|-----------|------------|----------|----------|------------|-----------|------------|------------|------------|------------|-----------|----------|------------|
| Beïnvloedbaarheid       | 0,5        | 1         | 1         | 0          | 0        | 0        | 0          | 1         | 0          | 0          | 0          | 0          | 0         | 1        | 1          |
| Probleeminzicht         | 0,5        | 1         | 1         | 0          | 0        | 0        | 0,5        | 1         | 0,5        | 0,5        | 0,5        | 0,5        | 0,5       | 0,5      | 0,5        |
| Psychose                | 0          | 1         | 1         | 0          | 1        | 0        | 0,5        | 1         | 0          | 1          | 1          | 0          | 0         | 0,5      | 0,5        |
| Verslaving              | 0          | 1         | 1         | 0          | 0        | 0        | 0,5        | 1         | 0          | 0,5        | 0,5        | 0,5        | 0,5       | 0,5      | 1          |
| Impulsiviteit           | 0          | 1         | 1         | 0          | 0        | 0        | 0,5        | 0,5       | 0          | 0          | 0          | 0          | 1         | 1        | 1          |
| Anti-sociaal gedrag     | 1          | 1         | 1         | 0          | 0        | 0        | 0          | 0,5       | 0          | 0          | 0          | 0          | 0         | 0,5      | 0          |
| Vijandigheid            | 1          | 1         | 1         | 0          | 0        | 0        | 0          | 0,5       | 0          | 0          | 0          | 0          | 0         | 0,5      | 0          |
| Sociaal Gedrag          | 1          | 0,5       | 1         | 0,5        | 0,5      | 0,5      | 0,5        | 1         | 0,5        | 0          | 0          | 0          | 0         | 1        | 0          |
| Zelfredzaamheid         | 0          | 1         | 1         | 1          | 0        | 0        | 0,5        | 0,5       | 1          | 1          | 1          | 1          | 1         | 1        | 1          |
| Behandelbereidheid      | 0          | 1         | 0,5       | 0          | 0        | 1        | 0,5        | 1         | 0          | 0          | 0          | 0          | 0         | 1        | 1          |
| Verantwoordelijkheid    | 0          | 1         | 1         | 0,5        | 0        | 0        | 0          | 1         | 0,5        | 1          | 1          | 0,5        | 1         | 1        | 1          |
| Copingvaardigheden      | 1          | 1         | 1         | 0          | 0        | 0        | 1          | 1         | 0          | 0          | 0          | 0          | 0         | 0        | 1          |
| Afspraken               | 0,5        | 0,5       | 0,5       | 0,5        | 0,5      | 0,5      | 0          | 0         | 0,5        | 1          | 0,5        | 0          | 0         | 0,5      | 0,5        |
| Arbeidsvaardigheden     | 0          | 0         | 0         | 1          | 0        | 0        | 0          | 0         | 0,5        | 0,5        | 0          | 0          | 0         | 0        | 1          |
| <b>Total importance</b> | <b>5,5</b> | <b>12</b> | <b>12</b> | <b>3,5</b> | <b>2</b> | <b>2</b> | <b>4,5</b> | <b>10</b> | <b>3,5</b> | <b>5,5</b> | <b>4,5</b> | <b>2,5</b> | <b>4</b>  | <b>9</b> | <b>9,5</b> |

## Appendix W. Decision tables recommended and default values scoring systems

Table 52. Scoring systems for care path psychosis.

| Activity                       | Type               | Possible scoring systems       | Recommend  | Default                 |
|--------------------------------|--------------------|--------------------------------|------------|-------------------------|
| <b>eHealth &amp; Education</b> | Cognitive          | Linear, increasing             | Increasing | 10, $+0.75(x-1)$        |
| <b>Training O</b>              | Cognitive & Social | Linear, increasing             | Increasing | 10, $+0.75(x-1)$        |
| <b>Therapy O</b>               | Cognitive          | Linear, increasing             | Increasing | 10, $+0.75(x-1)$        |
| <b>Occupational therapy O</b>  | Cognitive & Social | Linear, increasing             | Increasing | 10, $+0.75(x-1)$        |
| <b>Sports O</b>                | Physical           | Linear, increasing             | Linear     | 6, $+0.5(x-1)$          |
| <b>Labor O</b>                 | Physical           | Linear, increasing             | Linear     | 6, $+0.5(x-1)$          |
| <b>eHealth Education B</b>     | Cognitive & Social | Linear, increasing, completion | Linear     | 8, $+0.75(x-1)$ , +20%  |
| <b>Therapy B</b>               | Cognitive          | Linear, increasing, completion | Increasing | 8, $+0.75(x-1)$ , +20%  |
| <b>Training B</b>              | Cognitive          | Linear, increasing, completion | Completion | 10, $+0.75(x-1)$ , +20% |
| <b>Occupational therapy B</b>  | Cognitive & Social | Linear, increasing, completion | Completion | 10, $+0.75(x-1)$ , +20% |
| <b>iPad</b>                    | Cognitive          | Linear, increasing, maximum    | Increasing | 8, $+0.75(x-1)$ , +20%  |
| <b>MD</b>                      | Cognitive          | Linear, increasing, completion | Maximum    | 6, $+0.5(x-1)$ , 16x    |
| <b>Sports B</b>                | Physical           | Linear, increasing, completion | Completion | 10, $+0.5(x-1)$ , +20%  |
| <b>Labor B</b>                 | Physical           | Linear, increasing, completion | Linear     | 6, $+0.5(x-1)$ , +15%   |
| <b>Get up on time</b>          | Physical           | Linear, increasing, completion | Linear     | 6, $+0.5(x-1)$ , +15%   |
| <b>Clean room</b>              | Cognitive          | Linear, increasing, maximum    | Linear     | 5, $+0.5(x-1)$ , 20x    |
| <b>Cook a healthy meal</b>     | Physical           | Linear, increasing, maximum    | Linear     | 5, $+0.5(x-1)$ , 20x    |
| <b>Arrange finances</b>        | Cognitive          | Linear, increasing, maximum    | Maximum    | 5, $+0.5(x-1)$ , 4x     |
| <b>Sports R</b>                | Physical           | Linear, increasing, completion | Maximum    | 5, $+0.5(x-1)$ , 4x     |
| <b>Labor R</b>                 | Physical           | Linear, increasing, completion | Linear     | 6, $+0.5(x-1)$ , +15%   |
| <b>Occupational therapy R</b>  | Physical           | Linear, increasing, completion | Linear     | 6, $+0.5(x-1)$ , +15%   |
| <b>Education R</b>             | Cognitive & Social | Linear, increasing, completion | Increasing | 8, $+0.75(x-1)$ , +20%  |
| <b>Social network</b>          | Cognitive          | Linear, increasing, completion | Increasing | 8, $+0.75(x-1)$ , +20%  |
| <b>Future steps</b>            | Social             | Linear, increasing             | Linear     | 8, $+0.75(x-1)$         |
|                                | Cognitive & Social | Linear, increasing, completion | Increasing | 8, $+0.75(x-1)$ , +20%  |

Table 53. Scoring systems for care path personality.

| Activity                       | Type               | Possible scoring systems | Recommend  | Default         |
|--------------------------------|--------------------|--------------------------|------------|-----------------|
| <b>eHealth &amp; Education</b> | Cognitive          | Linear, increasing       | Increasing | 10, $+0.5(x-1)$ |
| <b>Training O</b>              | Cognitive & Social | Linear, increasing       | Increasing | 10, $+0.5(x-1)$ |
| <b>Therapy O</b>               | Cognitive          | Linear, increasing       | Increasing | 10, $+0.5(x-1)$ |
| <b>Occupational therapy O</b>  | Cognitive & Social | Linear, increasing       | Increasing | 10, $+0.5(x-1)$ |
| <b>Sports O</b>                | Physical           | Linear                   | Linear     | 6               |
| <b>Labor O</b>                 | Physical           | Linear                   | Linear     | 6               |



|                               |                    |                                |            |                    |
|-------------------------------|--------------------|--------------------------------|------------|--------------------|
| <b>eHealth</b>                | Cognitive & Social | Linear, completion             | Linear     | 8, +20%            |
| <b>Education B</b>            | Cognitive          | Linear, increasing, completion | Increasing | 8, +.5(x-1), +20%  |
| <b>Therapy B</b>              | Cognitive          | Linear, increasing, completion | Completion | 10, +.5(x-1), +20% |
| <b>Training B</b>             | Cognitive & Social | Linear, increasing, completion | Completion | 10, +.5(x-1), +20% |
| <b>Occupational therapy B</b> | Cognitive & Social | Linear, increasing, completion | Linear     | 8, +.5(x-1), +20%  |
| <b>iPad</b>                   | Cognitive          | Linear, maximum                | Maximum    | 6, 16x             |
| <b>MD</b>                     | Cognitive          | Linear, increasing, completion | Completion | 10, +.5(x-1), +20% |
| <b>Sports B</b>               | Physical           | Linear, maximum, completion    | Maximum    | 6, 16x, +15%       |
| <b>Labor B</b>                | Physical           | Linear, maximum, completion    | Maximum    | 6, 40x, +15%       |
| <b>Get up on time</b>         | Cognitive          | Linear, completion             | Linear     | 5, 20x             |
| <b>Clean room</b>             | Physical           | Linear, completion             | Maximum    | 5, 4x              |
| <b>Cook a healthy meal</b>    | Physical           | Linear, completion             | Linear     | 5, 20x             |
| <b>Arrange finances</b>       | Cognitive          | Linear, completion             | Maximum    | 5, 4x              |
| <b>Sports R</b>               | Physical           | Linear, maximum, completion    | Maximum    | 6, 16x, +15%       |
| <b>Labor R</b>                | Physical           | Linear, maximum, completion    | Maximum    | 6, 40x, +15%       |
| <b>Occupational therapy R</b> | Cognitive & Social | Linear, increasing, completion | Linear     | 8, +.5(x-1), +20%  |
| <b>Education R</b>            | Cognitive          | Linear, increasing, completion | Increasing | 8, +.5(x-1), +20%  |
| <b>Social network</b>         | Social             | Linear, increasing             | Linear     | 8, +.5(x-1)        |
| <b>Future steps</b>           | Cognitive & Social | Linear, increasing, completion | Increasing | 8, +.5(x-1), +20%  |

For the recommended scoring systems and default values a value was chosen with the following criteria:

1. Time spent on activity
2. Amount of effort spent on activity
3. Importance of activity for either treatment or resocialization
4. Care path client

#### **Explanation for linear default values:**

10 = treatment focused

8 = semi treatment focused, but still important for progress inside DWP or resocialization

6 = semi treatment focused, less important for progress inside DWP or resocialization or it takes less time in comparison to activities that score value 8

5 = activities of ADL category

#### **Explanation for increasing default values:**

+ .75(x-1) = clients with care path psychosis and treatment focused

+ .5(x-1) = clients with care path psychosis and semi-treatment focused

+ .5(x-1) = clients with care path personality and treatment focused

For this scoring system, it was evaluated whether the total points at the end of the 4 weeks would be in proportion with the original points. So for example, on the basis of the pilot it could be concluded that on average, a client with care path personality has 3 therapy blocks a week which means 12 therapy

blocks per month. This would result in  $10+.5(12-1)=15.5$  points for therapy at the end of the month. This would still be in proportion to the original points that would be rewarded for therapy.

**Explanation for maximum default values:**

Maximum score is 4 times linear score = Activities that does not need to be performed more once a week

Maximum score is 16 times linear score = Activities that does not need to be performed more than 4 times per week

Maximum score is 20 times linear score = Activities that should be performed maximally 1 time per day, weekend days excluded

Maximum score is 40 times linear score = Activities that should be performed maximally 2 times per day, weekend days excluded

**Explanation for completion default values:**

+ 20% = when treatment or semi treatment focused, but still important for progress inside DWP or resocialization

+15% = when semi treatment focused, less important for progress inside DWP or resocialization or it takes less time in comparison to activities that score value 20%

For this scoring system, the values of the bonus points were chosen as follows. Just like the example of the increasing scoring systems, the average client with care path personality has 3 therapy blocks a week which means 12 therapy blocks per month. Suppose that the goal of a client is to go at least 10 times to therapy. This would result in a bonus score of  $.2(10*10)=20$  bonus points on top of the 100 points that were received for going to therapy. This would result in 120 points which can be seen as a decent bonus for going to therapy. Since the semi-treatment focused activities take less effort or are more often performed in a week, it was decided to give less bonus points for these activities.

## Appendix X. Quick design decision support tool

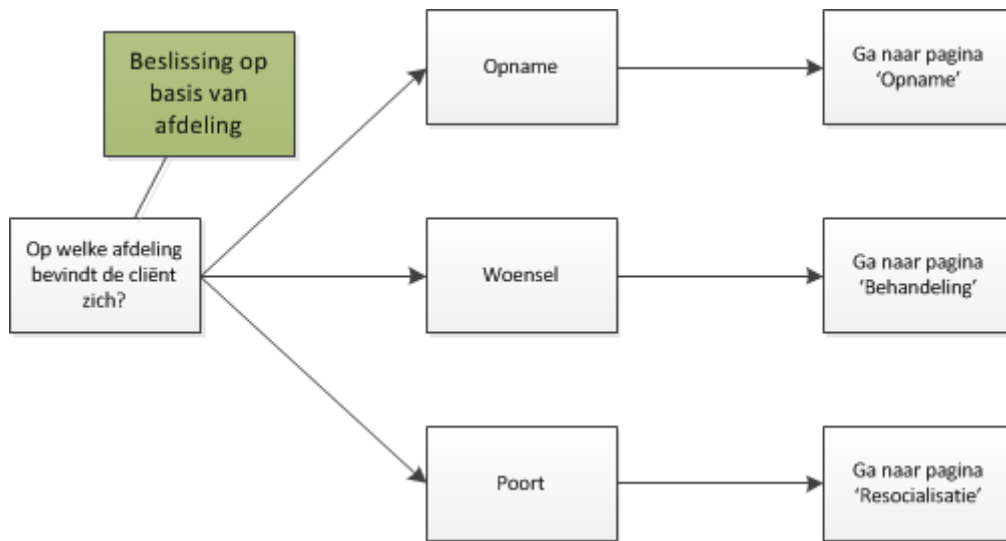


Figure 41. Decision tree start.

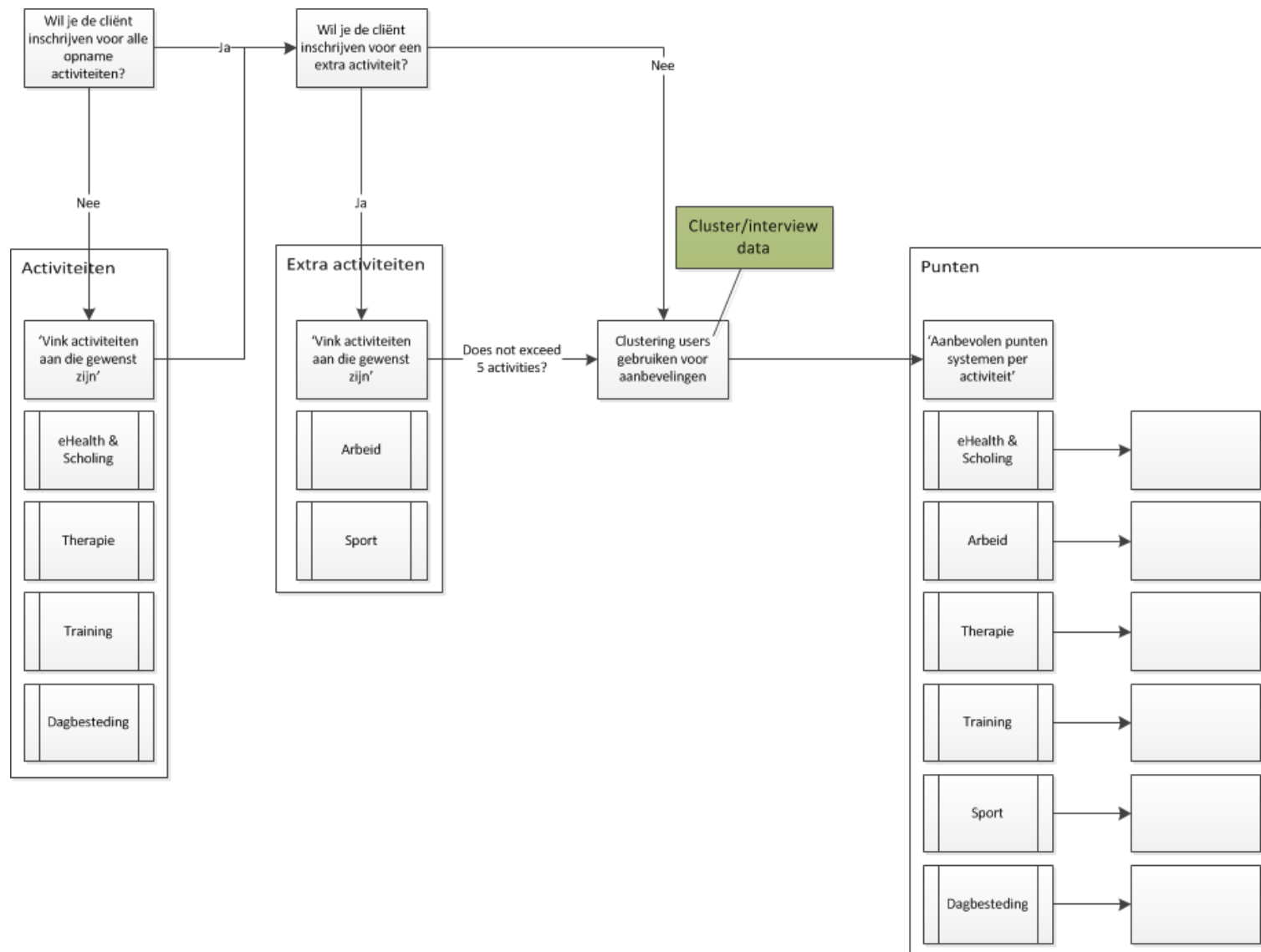


Figure 42. Decision tree hospitalization phase.

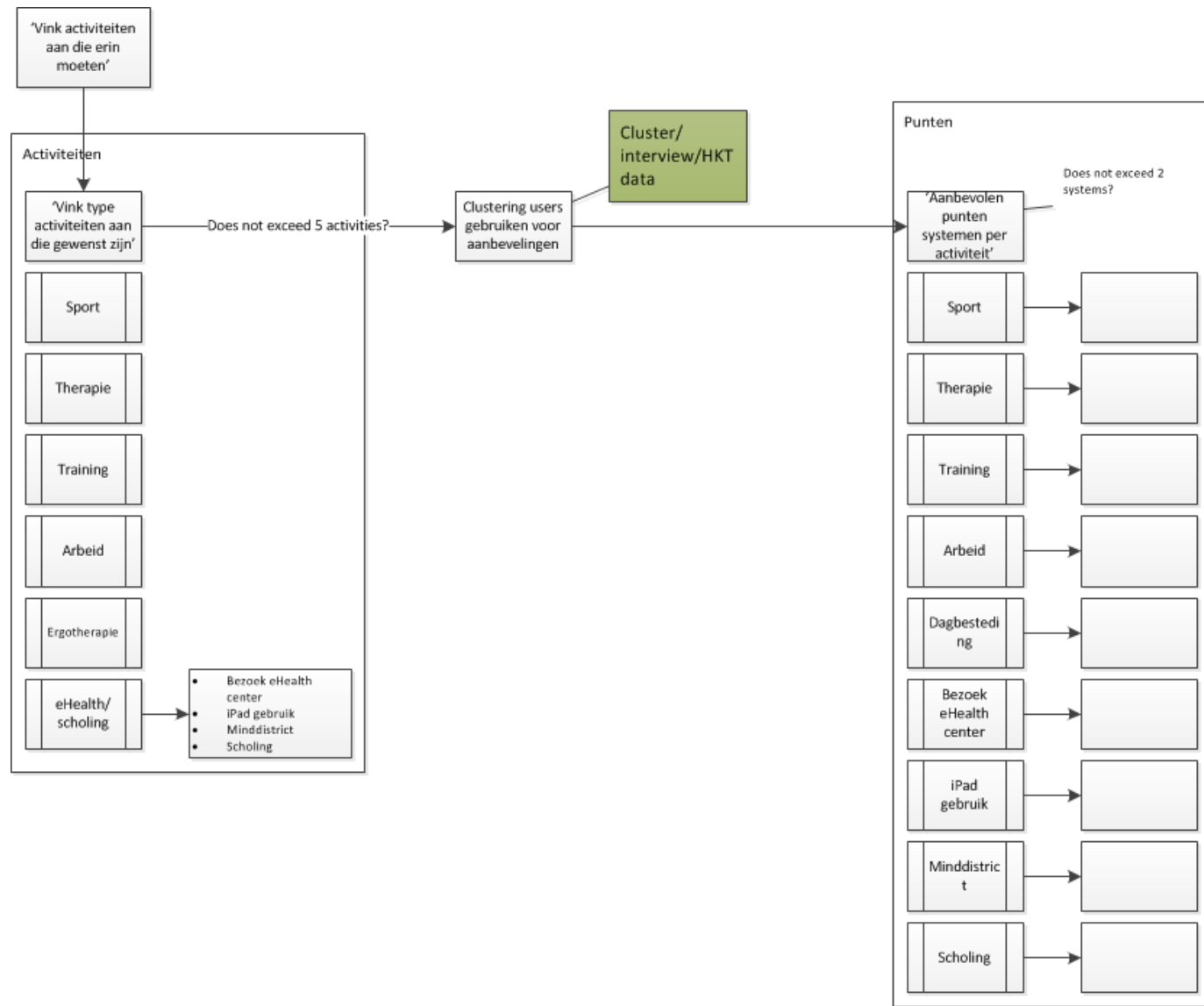


Figure 43. Decision tree treatment phase.

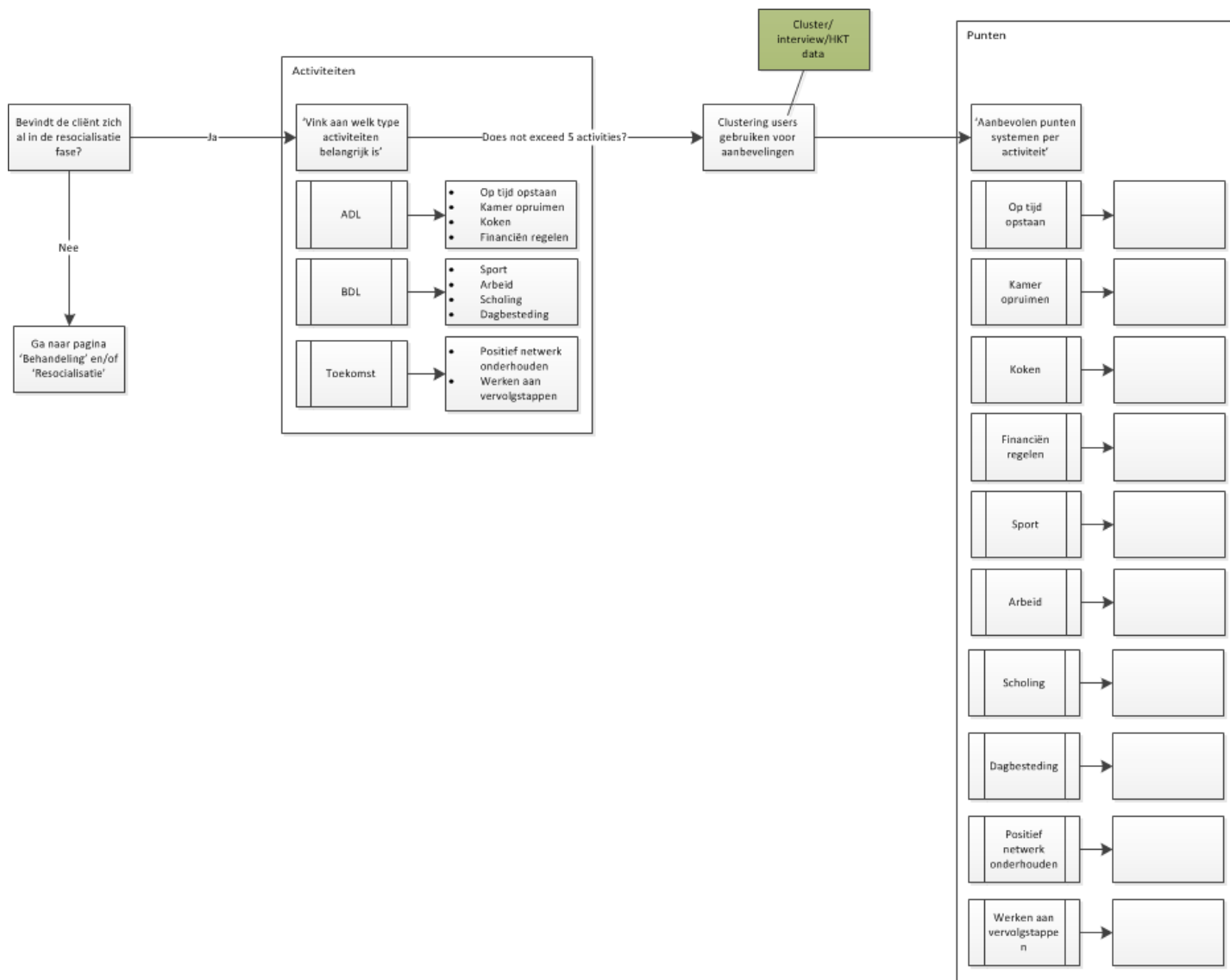


Figure 44. Decision tree resocialization phase

## Appendix Y. Results testing decision support tool

Table 54. Results testing decision support tool per persona.

|                       | HKT factors           | Score            | Difficulties | Results  |
|-----------------------|-----------------------|------------------|--------------|----------|
| Gregory               | Influenceability      | 3                | Cognitive    |          |
|                       | Problem understanding | 3                |              |          |
|                       | Psychoses             | 2                |              |          |
|                       | Addiction             | 3                |              |          |
|                       | Impulsiveness         | 4                |              |          |
|                       | Antisocial behavior   | 3                |              |          |
|                       | Hostility             | 4                |              |          |
|                       | Social behavior       | 1                |              |          |
|                       | Self-reliance         | 3                |              |          |
|                       | Treatment readiness   | 1                |              |          |
|                       | Responsibility        | 1                |              |          |
|                       | Coping skills         | 5                |              |          |
|                       | Appointments          | 1                |              |          |
|                       | Labor skills          | 2                |              |          |
|                       | Richard               | Influenceability |              | 3        |
| Problem understanding |                       | 3                |              |          |
| Psychoses             |                       | 2                |              |          |
| Addiction             |                       | 3                |              |          |
| Impulsiveness         |                       | 4                |              |          |
| Antisocial behavior   |                       | 2                |              |          |
| Hostility             |                       | 2                |              |          |
| Social behavior       |                       | 2                |              |          |
| Self-reliance         |                       | 3                |              |          |
| Treatment readiness   |                       | 2                |              |          |
| Responsibility        |                       | 3                |              |          |
| Coping skills         |                       | 3                |              |          |
| Appointments          |                       | 3                |              |          |
| Labor skills          |                       | 3                |              |          |
| Bas                   |                       | Influenceability | 2            | Social & |
|                       |                       | 4                | Physical     |          |

|        |                  |   |          |                        |                           |          |         |       |
|--------|------------------|---|----------|------------------------|---------------------------|----------|---------|-------|
|        | Problem          |   |          |                        |                           |          |         |       |
|        | understanding    | 3 |          | <b>Ehealth</b>         | <b>Aanbevolen</b> Lineair | Stijgend | Maximum | Bonus |
|        | Psychoses        | 1 |          | <b>TrainingB</b>       | Lineair                   | 1        | 0       | 30%   |
|        | Addiction        | 3 |          | <b>Dagbesteding</b>    | Bonus                     | 13       | 1       | 0     |
|        | Impulsiveness    | 4 |          | <b>iPad</b>            | Stijgend                  | 11       | 1       | 0     |
|        | Antisocial       |   |          | <b>MD</b>              | Maximum                   | 8        | 0,7     | 16    |
|        | behavior         | 1 |          |                        | Bonus                     | 12       | 0,7     | 0     |
|        | Hostility        | 4 |          |                        |                           |          |         | 25%   |
|        | Social behavior  | 1 |          |                        |                           |          |         |       |
|        | Self-reliance    | 3 |          |                        |                           |          |         |       |
|        | Treatment        |   |          |                        |                           |          |         |       |
|        | readiness        | 5 |          |                        |                           |          |         |       |
|        | Responsibility   | 2 |          |                        |                           |          |         |       |
|        | Coping skills    | 1 |          |                        |                           |          |         |       |
|        | Appointments     | 1 |          |                        |                           |          |         |       |
|        | Labor skills     |   |          |                        |                           |          |         |       |
| Saskia | Influenceability | 3 | Physical |                        |                           |          |         |       |
|        | Problem          | 2 |          | <b>Koken</b>           | <b>Aanbevolen</b> Lineair | Stijgend | Maximum | Bonus |
|        | understanding    |   |          | <b>Financien</b>       | Lineair                   | 8        | 0,75    | 20    |
|        | Psychoses        | 2 |          | <b>ScholingB</b>       | Maximum                   | 7        | 0,7     | 4     |
|        | Addiction        | 3 |          | <b>Sociaal netwerk</b> | Stijgend                  | 9        | 0,9     | 0     |
|        | Impulsiveness    | 3 |          | <b>Vervolgstappen</b>  | Lineair                   | 9        | 0,9     | 0     |
|        | Antisocial       | 2 |          |                        | Stijgend                  | 9        | 0,9     | 0     |
|        | behavior         |   |          |                        |                           |          |         | 20%   |
|        | Hostility        | 2 |          |                        |                           |          |         |       |
|        | Social behavior  | 2 |          |                        |                           |          |         |       |
|        | Self-reliance    | 3 |          |                        |                           |          |         |       |
|        | Treatment        | 2 |          |                        |                           |          |         |       |
|        | readiness        |   |          |                        |                           |          |         |       |
|        | Responsibility   | 1 |          |                        |                           |          |         |       |
|        | Coping skills    | 1 |          |                        |                           |          |         |       |
|        | Appointments     | 3 |          |                        |                           |          |         |       |
|        | Labor skills     | 1 |          |                        |                           |          |         |       |



**Appendix Z.      Typed and coded interviews**