EclipseCon, Toulouse, France
24-25 June 2015

What’s the BIG idea?
Business Intelligence using Gamification - Evaluating the effects on user engagement

Stephen Miller
University of the West of Scotland
Presentation aim

1. To outline the projects’ objectives
2. To show the projects value/contribution
3. To demonstrate why Eclipse BIRT was chosen
4. To highlight the processes & potential outcome
5. To generate a discussion and to seek advice
Content

Part I - Introduction
  • Overview

Part II - Main body
  • A real-world problem! The why?
  • Literature review
  • Research model
  • The project - ‘GamBIT’
  • Research design

Part III - Conclusion
  • Limitations/challenges/issues
  • Project plan
  • Q & A
Part I: Introduction - Research overview

Primary purpose:

“To apply the concept of Gamification to a Business Intelligence Tool and measure what effect it has on user engagement.” (Project ‘GamBIT’)
New relationships

Users

Business Intelligence

Gamification

AIM: ‘TO INVESTIGATE EFFECTS ON USER ENGAGEMENT’
The How?

• **Proof of concept (PoC)**
  
  Software prototype - Project ‘GamBIT’

• **Experiment**
  
  A/B testing

• **Analysis**
  
  (i) User Engagement Survey
  (ii) Analytics metrics
  (iii) Semi-structured interviews

• **When?**
  
  September 2015
Part II: Main Body - A research problem (the why?)

• **Aim:** I.D. a real-world problem

• **Method:** thorough literature review

• **Problem?:** lack of employee engagement in BI tools

• **Findings:** little research / fewer remedies

• **Action:** requires more research to find a **solution**

• **Solution?:** a technical app. to increase BI engagement
Performance measurement

Jack Welch, former CEO of GE:

“There are only three measurements that tell you nearly everything you need to know about your organisation’s overall performance:

(i) customer satisfaction

(ii) cash flow

(iii) employee engagement (EE)...

It goes without saying that no company, small or large, can win over the long run without energised employees who believe in the mission and understand how to achieve it…”

Source: http://www.hr.com/en/app/blog/2012/10/inspirational-employee-engagement-quotes
Employee Engagement (EE)
EE: Real-world problem

• EE **tops** employer priority list (60%)

• EE continues to be the **TOP** priority (Yr.-on-Yr.)

• **People** are the **key** to ‘competitive advantage’

• Major benefits of EE:
  
  - improved productivity + performance (87%)
  - increased customer/client satisfaction (66%)

Source: CBI + Harvey Nash/Accenture (Employment trends survey, 2012 / 2013)
EE in the UK - 2013

Engaged 33%
Indifferent 49%
Disengaged 18%

UK Engagement Index 14.8%

(http://www.customer-insight.co.uk/sites/default/files/emp-engagement.pdf)
BI engagement

- Not user friendly!
- Heavy reliance on ‘power users’ and IT
- Big ‘disconnect’ between IT + business users
- Poor ROI v. High TCO
- **Result** = only c.22% of all staff engaged in BI use - potential for c. 50% (Howson, 2014)
- **Result** = limited no. of ‘active’ bus. users (c.3-8%) (Evelson, 2010)
- Traditional BI – regarded as a bit of a ‘failure!’
BI adoption

BI Adoption Rate (Howson, 2013) (BI Scorecard)

%age of employees

<table>
<thead>
<tr>
<th>Year</th>
<th>2007</th>
<th>2009</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Mobile</th>
<th>Potential use</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>25%</td>
<td>24%</td>
<td>25%</td>
<td>24%</td>
<td>22%</td>
<td>42%</td>
<td>50%</td>
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</table>
Research rationale

- **Insufficient and disengaged** BI users - “HELP!!”
- **Employees** are an org’s greatest asset - **engage them!**
- **Data** is also a strategic asset - **exploit it ‘wisely’**
- **Research aim:**
  To create a ‘**prototype**’ that can be applied to a BI tool to engage employees so that those previously ‘**boring**’ and ‘**repetitive**’ data tasks become a bit more ‘**fun, engaging and participative**’ i.e. putting the **fun** into mundane = ‘**Fun’dane!’
Part II – Literature Review: Gamification

- 2 principal studies (< 2 years)

  1. **ERP tool** (Herzig et al, 2012)
  
  2. **PM system** (Aseriskis & Damasevicius, 2014)

- **ERP findings:**
  
  - **Improvements** in S/ware Enjoyment., Flow Xp. + PEOU (perceived ease of use)

- **PM findings:**
  
  - Gm system rated with **good usability** score (SUS = 71%)
Gamification (Gm)

• Gm aimed at increasing engagement + productivity

• **BI need:** Tech. solution to **tackle UE problem**

• Gm identified as a possible ‘**fit**’

• Innovative set of tools for **combating disengagement**

• Potential to make a **positive impact** on Prf, Prod’vy + Eng. of employees, users or customers (Kankanhalli et al, 2012)

• Yields **positive effects/results** (Hanari et al, 2014)

• Emerging technology trend (> c. 2010-11)
Gamification (peak)
Gamification - what is it?

• Described as “the application of game elements to non-game contexts.” (Deterding, 2011) or “the integration of game dynamics into your site, services, community, content or campaign in order to drive participation” (Bunchball.com, 2010)

• Reward + competition

• Behaviour + habits

• Instant, positive + consistent feedback + connects smaller tasks to larger goals, making each action meaningful

• Target ext. initiatives > happy customers + bus. goals

• Target int. initiatives > keeping employees engaged...!
Gm frameworks

Example: 6 D’s (Werbech, 2011):

• Define business objectives (what am I trying to achieve?)
• Delineate target behaviours (success metrics + analytics indicators)
• Describe the players
• Devise activity loops (engagement + progression) (Cycle = motivation → action → feedback)
• Deploy the appropriate tools
• Don’t forget the FUN aspect!
Gamification?

Summing up:

- “One way to think of gamification is as the intersection of psychology and technology... understanding what motivates someone to ‘engage’ with certain elements of a website, an app, or what have you... It’s about humanising the technology and applying psychology and behavioural concepts to increase the likelihood that the technology will be used and used properly.”

(Duggan and Shoup, 2013)
Business intelligence (BI)

Definitions:

• “A set of methodologies, processes, architectures, and technologies that transform raw data into meaningful and useful information used to enable more effective strategic and operational insights and decision-making.” (Evelson, 2008)

• Bose (2009) insists the managerial view of BI is getting the right information to the right people at the right time so they can make decisions that ultimately improve enterprise performance.
Business intelligence (BI)

Purpose:
• (i) to follow the outcome of business operations (ii) to provide information (iii) analyse it when taking business decisions. (Popovic, Turk and Jaklic, 2006)

Objectives:
1. To provide a ‘single version of the truth’ across an entire organisation
2. To provide a simplified system implementation, deployment and administration
3. To deliver strategic, tactical and operational knowledge and actionable insight (Wu, Barash & Bartolini, 2007)
BI history

Then:

- Evolving over 35 years (Petrini and Pozzebon, 2009)
- MIS / ERP / EIS / SIS / DSS
- BI (as a term) replaced EIS / DSS / MIS (Thomsen, 2003)
- Earliest tools: General + financial mgt. / S&M (Kemp, 2006)

Now:

- Analytics
- CBI
- Mobile
- Cloud computing
- Big data
- Social media

(Ventana, 2012)
User Engagement Survey (UES)

- Many scales examined - **UES chosen** (O’Brien & Toms, 2008)
- **Fits project aims/obj’s:** ‘engagement’ i.e. UX of an IS?
- **UE:** ‘explains how & why app’s attract people to use them’ (Sutcliffe, 2010)
- **Challenging to measure** UE (User Engagement)
- Specially designed **questionnaire**
- **Plan B** - use the SUS (EFF-1, EFF-2, SAT factors)
- Prev. studies reveal wide range of factors to measure UE
- **UES:** 6 distinct factors
UES factors

- **Perceived usability (PU)** - user’s affective & cognitive responses (i.e. **frustration and effort**)
- **Novelty (NO)** - user’s **level of interest** in the task and the curiosity evoked
- **Aesthetic appeal (AE)** - user’s perceptions of the **visual appeal** of the UI
- **Focused attention (FA)** - the concentration of **mental activity, flow, absorption** etc...
- **Felt involvement (FI)** - user’s feelings of being ‘**drawn**’ in, **interested** and having ‘**fun**’ (**whoop**ee!)
- **Endurability (EN)** - user’s **overall evaluation** of the IS e.g. how likely to **return/recommend**
<table>
<thead>
<tr>
<th>Factor</th>
<th>Question</th>
<th>EN1</th>
<th>EN2</th>
<th>EN3</th>
<th>EN4</th>
<th>AE1</th>
<th>AE2</th>
<th>AE3</th>
<th>AE4</th>
<th>AE5</th>
<th>NO1</th>
<th>NO2</th>
<th>NO3</th>
<th>FI1</th>
<th>FI2</th>
</tr>
</thead>
<tbody>
<tr>
<td>FA1</td>
<td>When I was using ‘GamBIT’, I lost track of the world around me.</td>
<td>This ‘GamBIT’ experience did not work out the way I had planned.</td>
<td>I would recommend ‘GamBIT’ to appropriate others.</td>
<td>Using ‘GamBIT’ was worthwhile.</td>
<td>My ‘GamBIT’ experience was rewarding.</td>
<td>I liked the graphics and images used on the ‘GamBIT’ website.</td>
<td>The ‘GamBIT’ website appealed to my visual senses.</td>
<td>The ‘GamBIT’ website was aesthetically appealing.</td>
<td>The screen layout of the ‘GamBIT’ website was visually pleasing.</td>
<td>The ‘GamBIT’ website was attractive.</td>
<td>The content of the ‘GamBIT’ website incited my curiosity.</td>
<td>I would continue to go to the ‘GamBIT’ website out of curiosity.</td>
<td>I felt interested in my BI tasks on ‘GamBIT’.</td>
<td>I was really drawn into GamBIT’.</td>
<td>This ‘GamBIT’ experience was fun.</td>
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<tr>
<td>FA2</td>
<td>I blocked out things around me when I was using ‘GamBIT’.</td>
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<td>FA3</td>
<td>The time I spent on ‘GamBIT’ just slipped away.</td>
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<td>FA4</td>
<td>I was absorbed in my BI tasks on ‘GamBIT’.</td>
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<td>FA5</td>
<td>I was so involved in my BI task that I lost track of time.</td>
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<td>FA6</td>
<td>During this gamification experience I let myself go.</td>
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<td>FA7</td>
<td>I lost myself in ‘GamBIT’.</td>
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<td>PU1</td>
<td>I felt discouraged while on the ‘GamBIT’ website.</td>
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<td>PU2</td>
<td>I felt annoyed while visiting the ‘GamBIT’ website.</td>
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<td>PU3</td>
<td>Using ‘GamBIT’ was mentally taxing.</td>
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<td>PU4</td>
<td>I found ‘GamBIT’ confusing to use.</td>
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<tr>
<td>PU5</td>
<td>I felt frustrated while visiting the ‘GamBIT’ website.</td>
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<tr>
<td>PU6</td>
<td>I could not do some of the things I needed to do on the ‘GamBIT’ website.</td>
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Part II: Research model

Research question:

How will the application of a Gm framework on a chosen BI tool affect user engagement and which user engagement factors will be notably enhanced, if any?
Conceptual framework

Transformational Process

Input

WWW

Input

Web Platform

Output

Architectural Framework for Project GamBIT

Business Benefits

- Engaged employees
- Increased business value
- Better decision-making
- Improved productivity
- Motivated employees
- Increased performance

Evaluation process

engagement

Outcome
Formal hypotheses

• A number of hypotheses have been formulated to ‘test’ the research theory that:

  “the application of gamification upon a BI tool will have a positive effect on the levels of user engagement i.e. they will increase.”

• The null hypothesis being “that there will be no difference to engagement levels, if applied.”
<table>
<thead>
<tr>
<th>No.</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1a</td>
<td>Focused attention (FA) has a positive effect on perceived usability (PU).</td>
</tr>
<tr>
<td>H1b</td>
<td>If FA is considerably higher in BI-2 than BI-1 AND hypothesis H1a is true, then PU is higher in BI-2 than in BI-1.</td>
</tr>
<tr>
<td>H2a</td>
<td>FA has a positive effect on felt involvement (FI).</td>
</tr>
<tr>
<td>H2b</td>
<td>If FA is considerably higher in BI-2 than BI-1 AND hypothesis H2a is true, then FI is higher in BI-2 than in BI-1.</td>
</tr>
<tr>
<td>H3a</td>
<td>Novelty (NO) has a direct positive effect on FI.</td>
</tr>
<tr>
<td>H3b</td>
<td>If NO is considerably higher in BI-2 than BI-1 AND hypothesis H3a is true, then FI is higher in BI-2 than in BI-1.</td>
</tr>
<tr>
<td>H4a</td>
<td>Aesthetics (AE) has an affirmative effect on FI.</td>
</tr>
<tr>
<td>H4b</td>
<td>AE will be greater in BI-2 than in BI-1.</td>
</tr>
<tr>
<td>H5a</td>
<td>NO has a positive effect on PU.</td>
</tr>
<tr>
<td>H5b</td>
<td>If NO is significantly higher in BI-2 than BI-1 AND hypothesis H5a is true, then PU is higher in BI-2 than in BI-1.</td>
</tr>
<tr>
<td>H6a</td>
<td>PU has a positive effect on FI.</td>
</tr>
<tr>
<td>H6b</td>
<td>PU will be greater in BI-2 than BI-1.</td>
</tr>
<tr>
<td>H7a</td>
<td>FI has a positive effect on endurability (EN).</td>
</tr>
<tr>
<td>H7b</td>
<td>If FI is significantly greater in BI-2 than in BI-1 AND hypothesis H7a is true, then the overall evaluation (EN) is higher in BI-2 than in BI-1.</td>
</tr>
</tbody>
</table>
Hypotheses framework

Users interacting with 'GamBIT'

Focused Attention (FA)

Novelty (NO)

Perceived Usability (PU)

Felt Involvement (FI)

Aesthetics (AE)

Endurability (EN)

H1

H2

H4

H5

H6

H3

Transforming users

Input

Output

Outcome
5-stage research process

- Design
- Develop
- Test
- Implement
- Evaluate
5-stage research process

Stage 1 - Design
Select a BIT + Gam-f/work and design architecture

Stage 2 - Develop
Develop the architecture – BI tool + gamification strategy

Stage 3 - Test
Continue building + testing prototype

Stage 4 - Implement
Finalise all testing + ‘Go-live’ via web + monitor activity

Stage 5 - Evaluate
Establish appropriate evaluation techniques

Learn BIRT
Learn Java/SQL-Gm frameworks
Set obj’s/game rules

Strip/rebuild BIRT + create ‘GamBIT’ site (rewards/levels/widgets etc..)

Reiterate the process until it meets project objectives

Select random groups for A/B testing (UWS computing students)

Apply UES + system analytics + Conduct SS interviews
Technical framework

- Select **Gm framework**
- Establish **Gm rules** + mechanics
- Create **Gm design** (points, badges, levels, challenges etc...)
- **Gm platform/architecture** (web-based? desktop app.?)
- **Analytics** engine/metrics
- Match **GBD with BI** application/use
- Set up Business Rules Mgt. System (**BRMS**) - Bus. Logic
- Apply **prog. languages** (Java, HTML, CSS, JS, XML etc...)
- Apply **GaML** (?)
Technical framework

- **Knowledge Layer** (Classic Cars)
- **Operations Layer**
  - Gamification
  - Eclipse BIRT
- **Presentation Layer**

- **Security**
- **Systems Management**
- **Communications**
Selection of a BI tool:

Options:

1. Proprietary system
2. Creating own system
3. Open Source (OS) - preferred option

Survey of OS tools/providers conducted:

- Selection criteria set
- Pentaho / Palo / Jaspersoft / Spago / Report Server
- **Eclipse BIRT** selected as best choice
BIRT (Business Intelligence & Reporting Tool)

What is it? (some quick facts)

- **Top-level** software **project** (IBM, Actuate, Cisco)
- Not-for-profit **consortium** + OS developers
- Uses Eclipse platform (IDE, JDT, SDK)
- **No cost** to users
- Most widely adopted OS-BI platform (**12M downloads**)
- **2.5M developers** across 157 countries
- **Java-based** application (built on plug-in’s)
- Great for **developing/dismantling, rebuilding/customising**
- Easy to download, **install** + work with (which I can testify...!)
High Level BIRT Architecture

Report Designer
- Eclipse Report Designer
- Eclipse DTP ODA
- Chart Designer
- Custom Designer

Report Design Engine

Report Engine
- Data Transf. Services
- Charting Engine
- Generation Services
- Presentation Services

XML Report Design

Data

Report Document

HTML
PDF
WORD
EXCEL
P/POINT
High Level BIRT Architecture (featuring ‘GamBIT’)

Report Designer
- Eclipse Report Designer
- Eclipse DTP ODA
- Chart Designer
- Custom Designer

Report Design Engine

Report Engine
- Data Transf. Services
- Charting Engine
- Generation Services
- Presentation Services

Project ‘GamBIT’

XML Report Design

HTML
PDF
EXCEL
P/POINT

Data

Report Document
Hello, Graeme... Welcome to Project GamBIT. I hope you enjoy... Stephen

OK
GamBIT/BIRT

Elements, rules & designs:

Any ‘game’ system should have the following **four critical elements** to be successful: (Salen and Zimmerman, 2004)

1. **Rules** (e.g. how to carry out BI tasks in order to get to the top of Mount ‘Gambit’)

2. **Players** (e.g. students qualified in BI)

3. **Struggle** i.e. an artificial conflict (e.g. climbing a ‘virtual’ mountain)

4. **Goals** i.e. quantifiable outcomes (e.g. reaching base camps (levels) & eventually the top if the BI tasks & reports are completed as per the set criteria).
GamBIT/BIRT

Experiment (quick overview)

- Participants **carry out BI tasks**
- (i) **Simple report** (ii) chart report + (iii) export it
- Both groups work on **same tasks with same functionality**
- **Time-bound** & send to appt. person
- Simulates BI definition: **right/info to r/people @ r/time**
- Every **task/skill** has a **value** (= points = ft. climbed)
- **Points/badges** are **awarded** but can also be **withdrawn**
- The **more points/badges (ft.) = higher up Mt. GamBIT**
- **Base camps** = skills level (badge image of; food, drink, ropes, axes!)
- Individual/all **progress shown** on image of Mt. GamBIT
- Administrators can **observe progress**
- Own (designed) **flag pitched** when **summit reached**
‘GamBIT’ in progress!
Well done Stephen on becoming a BI Master!
• **Study objectives**: ID what is being measured and how it fits with the RQ’s

• **Variables**: images, perceptions or concepts that can be measured (Dawson, 2002; Kumar, 2005; Kothari, 1985) - **D.V.:** U.E.; **I.V.:** Gm; **C.V.:** designed out

• **Philosophy**: a belief or assumption about a phenomenon & the way data is collected, analysed and used. Chosen Paradigm: **Methodological assumptions**

• **Sub-category**: **Positivist approach** = Methodological **positivism** (concepts of knowledge, social reality & science)

• **Purpose**: to ‘test’ hypotheses about ‘**cause and effect**’ (Kotler et al, 2006)
Research design (considerations)

- **Context**: controlled experiment simulating bus. env.
- **Classification**: experimental research
- **Approach**: mostly quantitative (‘explaining phenomena by collecting numerical data that are analysed using mathematically based methods’) (Aliaga and Gunderson, 2002)
- **Strategy**: answered survey questions = ‘true experimental design’
- **T.E.D.**: randomly selected participants increases validity; control group to compare results; **Type**: ‘post-test-only’

Control Group Design
## ‘P.T.O.’ - C.G.D.

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<tr>
<th>Steps</th>
<th>Standard Procedure</th>
<th>Aim</th>
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<tbody>
<tr>
<td>Step 1</td>
<td>Random assignment for the <strong>control group</strong></td>
<td>Random assignment for the <strong>experimental group</strong></td>
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<tr>
<td>Step 2</td>
<td>No treatment</td>
<td>Treatment</td>
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<tr>
<td>Step 3</td>
<td>Post-test</td>
<td>Post-test</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Steps</th>
<th>Procedure for ‘GamBIT’</th>
<th>Aim</th>
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<tbody>
<tr>
<td>Step 1</td>
<td>Random assignment for the <strong>control group</strong> – group A</td>
<td>Random assignment for the <strong>experimental group</strong> – group B</td>
</tr>
<tr>
<td>Step 2</td>
<td>No treatment (use of the simplified BIRT tool)</td>
<td>Treatment (application of project ‘GamBIT’)</td>
</tr>
<tr>
<td>Step 3</td>
<td>Post-test (using the <strong>UES</strong>)</td>
<td>Post-test (using the <strong>UES</strong>)</td>
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</tbody>
</table>
Design overview (coherence)

- The required attention to the connections among the different parts of the design is crucial – it’s called **coherence** (Maxwell, 2004)
PART III: Conclusion - Limitations

- UWS computing students
- No. of students (c. 40)
- Own volition + own time
- Constraints on their time/studies
- Unfamiliar with BIRT tool
- BI tasks & functionality
- Questionnaire
- Interviews
- Experiment must occur: September 2015
Challenges/issues (just a few!!)

• Length of time to finalise subject matter
• Technical aspects of BI/BIRT
• Understanding GM, designing ‘GamBIT’ & Integrating the software
• Statistics
• Self-learning
• Time & stress
• Personal issues
• Alignment with project plan
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<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
<th>Start</th>
<th>Finish</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Learn Java + Eclipse BIRT + gamification techniques/frameworks</td>
<td>01/12/2014</td>
<td>31/12/2014</td>
<td>25d</td>
</tr>
<tr>
<td>2</td>
<td>Understand what each Java file does + its function within BIRT</td>
<td>07/01/2015</td>
<td>30/01/2015</td>
<td>16d</td>
</tr>
<tr>
<td>3</td>
<td>Strip BIRT of complex processes/Java files + simplify BIRT</td>
<td>02/02/2015</td>
<td>27/02/2015</td>
<td>20d</td>
</tr>
<tr>
<td>4</td>
<td>Test/reiterate the process as above until satisfied that it meets needs</td>
<td>02/03/2015</td>
<td>27/03/2015</td>
<td>20d</td>
</tr>
<tr>
<td>5</td>
<td>Establish gamification strategy suitable for BIRT + create project plan</td>
<td>30/03/2015</td>
<td>10/04/2015</td>
<td>16d</td>
</tr>
<tr>
<td>6</td>
<td>Progress the ‘design and development’ stages of gamification strategy</td>
<td>13/04/2015</td>
<td>15/05/2015</td>
<td>25d</td>
</tr>
<tr>
<td>7</td>
<td>Create web platform for BIRT + gamification platform interfaces</td>
<td>10/05/2015</td>
<td>12/06/2015</td>
<td>20d</td>
</tr>
<tr>
<td>8</td>
<td>Define all the elements, behaviours, rewards, levels, widgets &amp; apply</td>
<td>16/06/2015</td>
<td>31/07/2015</td>
<td>34d</td>
</tr>
<tr>
<td>9</td>
<td>Holiday</td>
<td>13/08/2015</td>
<td>24/08/2015</td>
<td>10d</td>
</tr>
<tr>
<td>10</td>
<td>Apply the gamification strategy on new platform + make final changes</td>
<td>18/08/2015</td>
<td>18/09/2015</td>
<td>24d</td>
</tr>
<tr>
<td>11</td>
<td>Begin the group A/B testing on UWS computing students studying BI</td>
<td>21/09/2015</td>
<td>09/10/2015</td>
<td>15d</td>
</tr>
<tr>
<td>12</td>
<td>Evaluate the gamification process for quantitative data</td>
<td>12/10/2015</td>
<td>13/11/2015</td>
<td>25d</td>
</tr>
<tr>
<td>13</td>
<td>Interview students for qualitative data</td>
<td>13/09/2015</td>
<td>13/11/2015</td>
<td>24d</td>
</tr>
<tr>
<td>14</td>
<td>Write up evaluation chapter</td>
<td>17/11/2015</td>
<td>10/12/2015</td>
<td>24d</td>
</tr>
</tbody>
</table>
And finally:

• Thank you for your attention...

• Questions, discussion & advice all welcome...