UNIVERSITY OF GOTHENBURG

Enhancing Requirements Elicitation and Validation with Gamification

Researching Requirements Engineering in combitation with Gamificaton using Action Research

Bachelor of Science Thesis in the Program
Software Engineering & Management

Jani Pasanen
University of Gothenburg
Chalmers University of Technology
Department of Computer Science and Engineering
Gothenburg, Sweden, June 2015

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Supervisor:
Eric Knauss, Chalmers University of Technology,
Department of Computer Science and Engineering

Examiner:
Boban Vesin, Chalmers University of Technology,
Department of Computer Science and Engineering

University of Gothenburg
Chalmers University of Technology
Department of Computer Science and Engineering
SE-412 96 Göteborg
Sweden
Telephone + 46 (0)31-772 1000

Department of Computer Science and Engineering
Göteborg, Sweden June 2016

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Jani Pasanen

University of Gothenburg

Chalmers University of Technology

Department of Computer Science and Engineering

Gothenburg, Sweden June 201 65

Abstract— The general problem for requirements engineering (RE) is that stakeholders are often not actively involved in requirements engineering, especially when dealing with a non-IT-based company. The availability, involvement and motivation of stakeholders are known issues within requirements engineering, and the active involvement of stakeholders in requirements engineering is crucial for the system under design to fulfill their expectations.

To overcome this problem, we use action research and a web based gamified platform, a website based on Wordpress to which gamification elements have been added, for gathering requirements with the stakeholders of an app that is to be developed, at our organisational partner. We drive forward together with our organizational partner to ensure requirements quality.

What I intend to find out is whether or not the web based gamified platform works for our organisational partner, if it does ease access for the stakeholders and if gamification does motivate them. Further, we intend to find out if crowd sourcing works at our organisational partner, and if it eases access to a large number of stakeholders.

*Keywords-**Action Research, Gamification, Wordpress, JavaScript, Requirements Engineering, Requirements Elicitation, User Story, Acceptance Criteria***

I. Introduction

In this study I combine gamification with Requirements Engineering (RE), while focusing on gathering high quality requirements for a mobile application. The general problem is that stakeholders are not often actively involved in RE, do not particiate and are not motivated, especially in the domain when dealing with a non-IT-based company. To overcome this problem, I will use action research, driving forward together with the organizational partner to ensure requirement quality. [1], [2]

A. Organisational partner

The organisational partner that I worked with was Star Bowling AB. The company consists of a bowling alley, restaurant, bar, office, conference rooms, and the games activities on the second floor consisting of shuffle board, car racing, virtual golfing, virtual shooting, mini car racing etc.

B. Background

The owner of Star Bowling wanted an app to be developed for the games activities department, which they call "aktivitet", that shall be used for keeping track of points and calculate a leaderboard automatically for competitions for customers that are called "trekamp" and "femkamp". These competitions consist of three or five of the competitions that Star Bowling host.

C. Statement of the problem

The general problem for requirements engineering (RE) is that stakeholders are often not actively involved in requirements engineering, especially when dealing with a non-IT-based company. The availability, participation and motivation of stakeholders are known issues within requirements engineering, and the active involvement of stakeholders in requirements engineering is crucial for the system under design to fulfill their expectations.

This is specifically interesting at Star Bowling where the employees, at the department for whom the app will be developed, work at different times and days so they are only once a month at the company, at the same time and day, and that is the monthly meeting, and the owner and the CEO are often out on business visits and other errands and come to the company at irregular times. So availability is an issue for the company and this is why this is of interest to investigate with Star Bowling.

D. Purpose of Study

The purpose of this study is to use a web based gamified platform for requirements engineering, which has gamification elements in it for gathering requirements with the stakeholders of an app that is to be developed, to find out if a web based gamified platform addresses the problem with availability, and to find out if gamification increases stakeholders motivation.

What I intend to find out is whether or not the web based gamified platform website with gamification elements works for Star Bowling, if it does ease access for the stakeholders, and if gamification does motivate them. Further, I intend to find out if crowd sourcing works at Star Bowling, and if it eases access to a large number of stakeholders.

E. Research Questions

1) **RQ1:** What effect does applying gamification to requirements engineering have on RE elicitation and validation?
2) **RQ2:** What effect do competitive gamification elements have on RE elicitation?

F. Methodology

For this research I used action research as defined in the paper by McKay & Marshall with the dual cycle processes, the theoretical (research interest) and the practical (the problem solving interest).

I research a real world problem (P), apply a solution to it, an intervention (F) and find out what the outcome of the intervention to P results in (A).

The Method problem solving (Mps) part of action research can be compared to consulting that combines with the focus on researching the result and measuring if the outcome was the desired one increases scientific rigour and discipline [2].

In action research you have two parallel cycles, one being the practical action/intervention to a problem and the second being the research focus on the result. This also addresses a perceived lack of impartiality and bias as the research is on the data from the stakeholders.

The research according to the paper must be designed in such way to enable new knowledge to be generated about F and/or A [2].

Five iterations of the action research cycle were done where the first two were a part of a pilot test with IT students and the following two were requirements elicitation at Star Bowling AB. A fifth iteration in the form of group brainstorming will be conducted later.

The first iteration was theoretical, or you could call it academical, where I did not have the practical cycle. I sent a written request with instructions to students to login to the web page, to enter user stories and acceptance criteria, how to do that and finally fill in a questionnaire of the experience. In this request I pointed students to look at the instructions page in the website first to get instructions on how they should do.

The second iteration was with the practical cycle, or consulting if you will, where I talked with students and asked them personally to do this task and also at the same time be available to answer their questions.

For the third iteration I did not use the practical cycle and had no direct involvement with the stakeholders. The improved questionnaire was used at the company for the first time. I send an email to the department email and also an internal message to everyone in the affected department with a request and in it I included instructions on what to do and how to do. Login to the site, enter user stories and acceptance criteria. But no one did so or responded back to me.

The fourth iteration was with the practical cycle included where I had direct involvement with the stakeholders. I held a workshop where I explained what to do and how and I also showed on the projector what I wanted the stakeholders to do in the site.

After the fourth iteration I had a follow up interview with the stakeholders and the outcome of the follow up meeting was that a fifth iteration will be arranged where a workshop will be held about the requirements elicitation where the elicitation will done done as a group work.

G. Scope & limitations

The scope of the study is to look into requirements engineering with gamificiation, what effect applying gamification to requirements engineering and competitive gamification elements have on have on RE elicitation while using a participatory website for gathering the requirements in the form of user stories and the validation of requirements as acceptance criteria.

This study is limited to students and the stakeholders at the Star Bowling for whom the app will be developed.

H. Results

The first iteration shows that without personal involvement, or consulting if you will, people will not do requirements engineering. The third cycle that was conducted at the company showed the same thing. At school, two students took the time to do RE while at the company no-one did so.

At the second iteration at school I contacted eleven people and they responded by testing the website and answering the questionnaire about their experience.

The third iteration was conducted with the company stakeholders instead of students but otherwise the same as in the first cycle with the exception of that the questionnaire was improved for the third iteration based on feedback from the first two iterations.

At the fourth iteration I got involved with the stakeholders at the company and as a consultant first held a workshop to practically show them what they should do and how they access the website, secondly got them to enter user stories and acceptance criteria and thirdly to answer the questionnaire intended for the third and fourth iteration at the company.

After the fourth iteration a follow up interview with some of the stakeholders, that wanted to give verbal feedback, was held. It became clear that many of the stakeholders thought this task was difficult and that I did not explain it well enough.

The answers to the questionnaire by the students and the stakeholders, and the answers to the interviews with the stakeholders at Star Bowling show that gamification made the entering of requirements in the form of user stories more fun. The stakeholders at Star Bowling particularly liked the leaderboard while the badges did not have as much positive effect. And so, indirectly gamification has the same effect on RE elicitation and validation since it is to think through the routines of the work that is done and what functionality needs to be in a system to support those routines.

I. Contribution

Further studies need to be made in the field of gamification for requirements engineering. I have conducted four iterations using actions research and verified that the problems with stakeholders availability, involvement and motivation being low for requirements engineering. The students showed this and also the stakeholders at the company. With out the owners, upper managements or department heads buy-in and actively pushing the colleagues to take this task as part of their work very little would have happened.

II. Background

Deterding et al. define gamification as, "the use of game design elements in non-game contexts" [3]. To motivate our study, Oscar Pedreira et al. conducted a systematic mapping of gamification in software engineering, and concluded that further work is needed in software process areas, such as requirements [4].

The related work of gamification used together with requirements engineering includes two papers, by Fernandes et al. and by Snijders et al. presenting gamified tools for requirements engineering. These works both suggest that gamification may enhance stakeholder involvement. [5], [6]

The paper by Lombriser et al. propose a conceptual model for evaluating competitive game elements for RE elicitation, and social game elements for RE. In the paper the authors conducted an experiment with one team using a online gamified platform and the control group did not use the platform.

They note that stakeholder engagement is often insufficient when conducting requirements engineering and this leads to too few and low-quality requirements. They focus on gathering agile requirements in the form of user stories and acceptance criteria. [7].

The master thesis by Lombriser is the detailed study and experiment that is refered to in the paper above. In this thesis the author goes into detail to research the effectiveness of gamification in requirements engineering in order to improve stakeholder engagement. The author developed an online digital platform for scenario-based RE supported with gamification [8].

In the paper by Arnarsson and Johanneson the authors used design science research as their research methodology. This is a methodology that is similar to action research with the exception of the part where the researcher gets practically involved in the research is not a part of design science research, according to the authors.

They split their work up in three iterations, or rather you could say three separate parts where they first conduct test on code coverage, the second one was test smell and the third one instant feedback. These are terminologies and tests related to unit testing of software.

Their results show that developers felt that the gamification tool motivated them to write more and better tests. The authors feel their contribution is that the study was successful in its task of motivating the developers at the participating company to write more and better unit tests and that Gamification had a positive effect on the detection of test smells [9].

In the paper by Johanneson and Ivarsson the authors conducted an experiment where one group of developers used gamified elements in tools for Unit Testing while the control group did not. They identify two obstacles for unit testing, the first is lack of motivation among developers to do unit testing and the second is lack of interest in software testing processes.

The purpose of their experiment and their study was to research how the concept of gamification can be used to increase the effectiveness of unit testing and increase the motivation and interest among software developers for unit testing.

In their experiment they had 24 subjects that were divided into two groups. Their results show that the experiment group that used gamification "found significantly more defects and received a significantly higher percentage of requirements covered by tests than the control group." Their results also show that the gamification group found the task significantly more interesting that the control group [10].

For designing the web based gamified platform and deciding on the structure and contents of it, for requirements engineering, I used the insights that the mapping study by Dicheva et al. [11] and the literature review by Hamari et al. [12] and the platform developed for the experiment in the paper by Lombriser et al. gives [7], [8].

The papers by Kalinauskas, by Bista et al and Gianetto et al. are all research in different context using gamification but using different research methodologies. They were used when drawing parallels with my research [13]–[16].

III. Action Research (Methodology)

For this research I use action research as outlined in the paper by McKay and Marshall [2]. I research a real world problem (P), apply a solution to it, an intervention (F), and find out what the outcome of the intervention to P, results in (A). To find out the outcome I use a questionnaire to gather in data from the users and follow up interviews with select people who are willing to participate. For the pilot test with students I use the pilot questionnaire, attached as Appendix A. For Iterations 3 & 4 at Star Bowling I use the final questionnaire, attached as Appendix B. This questionnaire is in Swedish so the questions are translated into English in Appendix C.

The Mps part of action research, problem solving method, can be compared to consulting. That combined with the focus on researching the result and measuring if the outcome is the desired one increases scientific rigour and discipline. In action research you have two parallel cycles, one being the practical action/intervention to a problem and the second being the research focus on the result. This also addresses a perceived lack of impartiality and bias as the research is on the data from the stakeholders.

Figure 3 shows action research viewed as a dual cycle process, problem solving in parallel with the research interest. Figure 1 and Figure 2 show the different stages of the dual cycle process of an iteration of action research which I use for this study.

The research according to the paper must be designed in such way to enable new knowledge to be generated about F and/or A.

A. Context

In the questionnaire I ask questions about what effect the gamification elements and the competitive nature of the gamification elements have on requirements elicitation and the users experience of using the platform. The research methodology we opt for is action research. I use a web based gamified platform that I develop to get stakeholders involved with gathering agile requirements in the form of user stories.

I use gamification incentives for RE validation, using the same platform for gathering acceptance criteria. Throughout this process, I critically assess the effects of gamification, through observation, questionnaires and follow up interviews.

The questionnaire that is used for the first two iterations use a scale of 1-7 while the questionnaire for the following two iterations use a scale of 1-6 to measure motivation etc. I choose to use the 1-6 scale for the third & fourth iterations because this scale has no neutral option and in that way force the person answering to choose more or less of what ever the options are. With the follow up interviews after the fourth iteration I gain further insight into the user experience with the platform and the task.

IV. Stakeholders, Surveys & Interviews

For this study both questionnaires and interviews were used to collect qualitative data. The quantitative data is gathered by using the questionnaires. Two different questionnaires are used, one adapted for students, is written in English and it asks additionally questions about the platform, its usability, the content in the pages on top of the questions about the gamification elements. The second questionnaire is adapted for the stakeholders at Star Bowling. It is written in Swedish and only asked the questions that are of interest for this study.

V. The Gamified Platform

For designing the gamified platform and deciding on the structure and contents of it, for requirements engineering, I used the insights that the mapping study by Dicheva et al. gave [11], that the literature review by Hamari et al. gave [12] and the platform developed for the experiment in the paper by Lombriser et al. [7]. A lot of the ideas for the content in the platform, the gamification rules, points, rewards, the badges came from the platform developed by Lombriser for his masters thesis and I picked up a lot inspiration from that thesis [8].

Implementation
The platform is an installation of Wordpress using the standard 2015 template, which has a white background, the menu system to the left of the page and the articles in the center.

Figure 4 shows the frontpage of the gamified platform. The menu and contents are in Swedish because it was most recently used by the stakeholders at Star Bowling.

For gamification the Wordpress plugin Captain Up[1] was used and actions that were counted on the site were

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[1]http://captainup.com
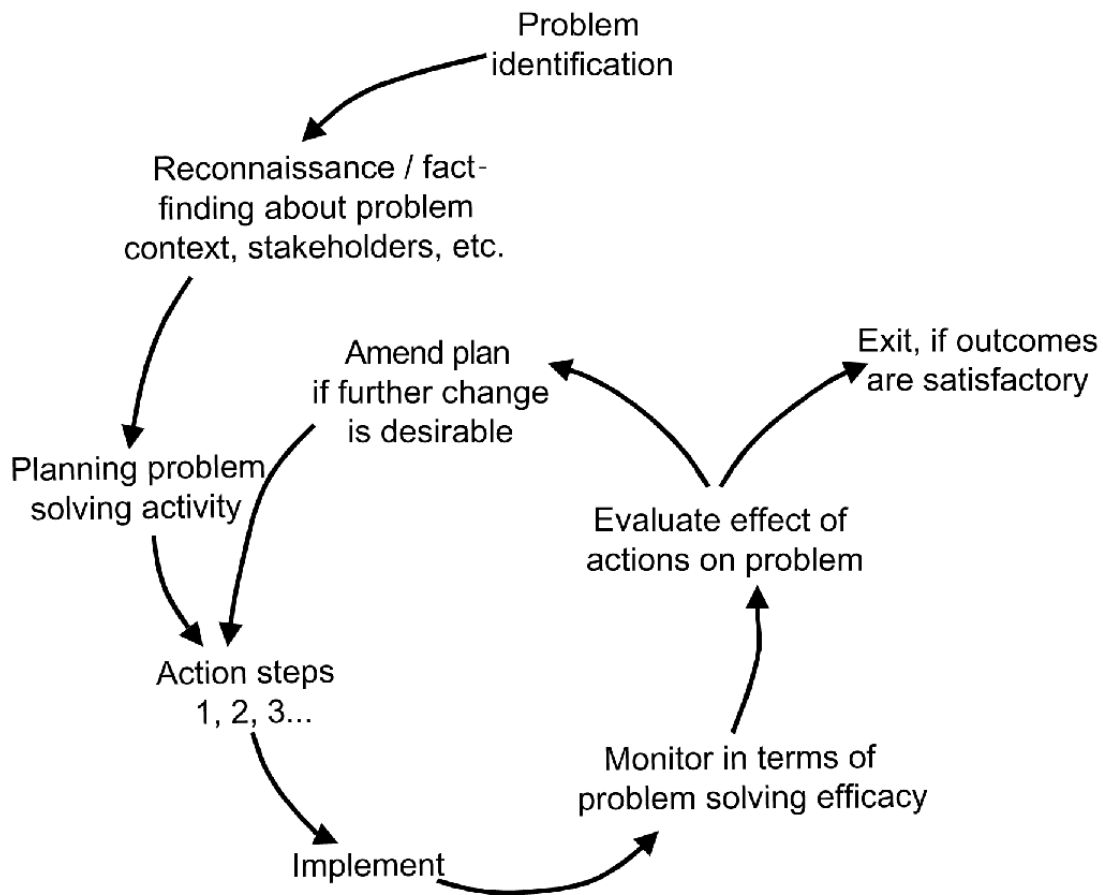
Figure 1: The problem solving in action research as outlined by McKay & Marshall [2].

reported using JavaScript actions to the Captain Up API which returns points and leaderboard as defined in the settings in the website of the plugin.

I installed plugins for measuring actions on the website, Google Analytics[2], SlimStat and WP Slimstat Analytics[3], that show which pages were visit, how long a visitor stayed at a certain page and to which page the user went after, which browser was used, what operating system and what screen size.

I installed the plugin SimpleMembersOnly[4] so that the user must login to the site using a valid account to display the content of the website and I installed the plugins Gravity Forms[5], Gravity Forms: Post Updates[6], that make it possible for the user to enter blog entries from the front page and the other that makes it possible to edit the entries from the front page. As standard, comments

can be entered and edited from the front page.

Workflow

Figure 5 shows the page for entering user stories. You have a header and the main body text where currently the predefined template for user stories is displayed. When a stakeholder enters a user story this text is replaced with the stakeholders contents. Once the stakeholder has typed in the text and pressed submit, here, "Skicka", it is time to enter acceptance criteria for the user story. This is done by commenting the user story that has been entered. An acceptance criteria is entered by pressing "Kommentera" under the user story that has been entered, see Figure 4.

Design

The Design of the platform has deliberately been left white without any extra content, colours or background pictures in order keep the user interface as clean and lean as possible. The menu is to the left and the content that is entered is in the center.

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[2]https://en.support.wordpress.com/google-analytics/
[3]https://sv.wordpress.org/plugins/wp-slimstat/
[4]https://sv.wordpress.org/plugins/simple-membership/
[5]http://www.gravityforms.com/
[6]https://wordpress.org/plugins/gravity-forms-post-updates/
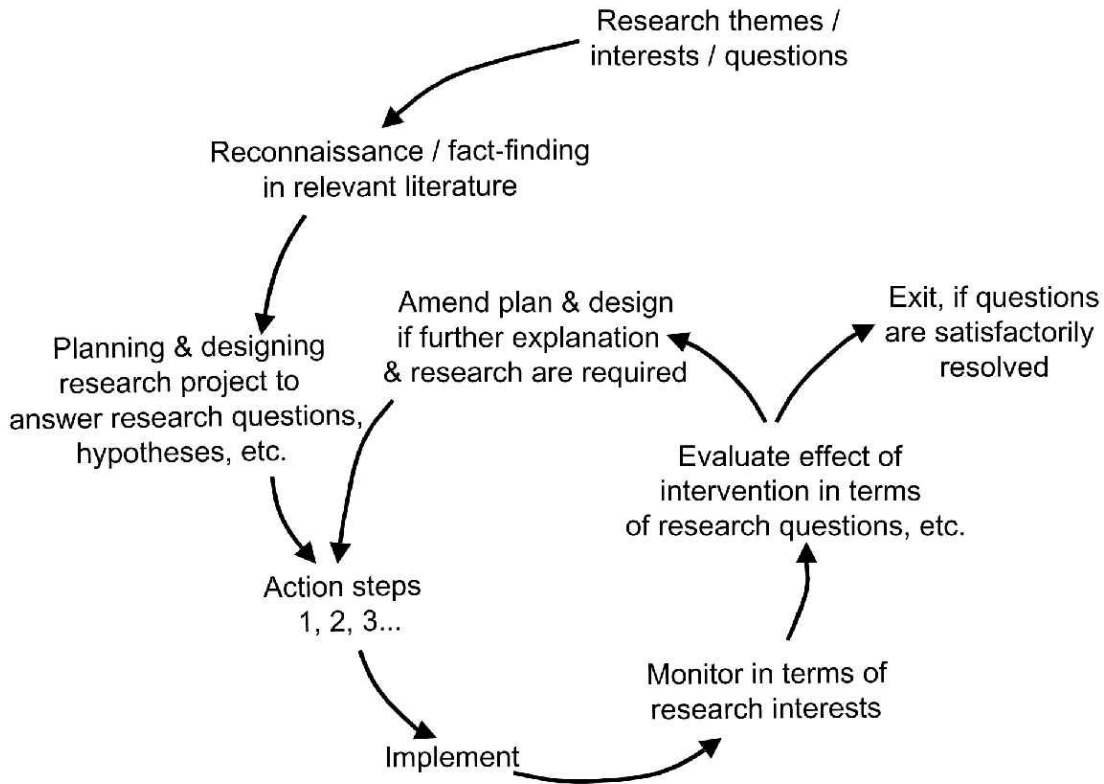
Figure 2: The research interest in action research as outlined by McKay & Marshall [2].
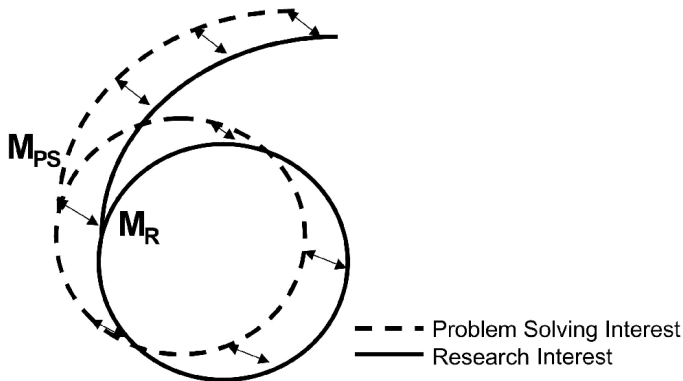
Figure 3: Action research viewed as a dual cycle process as outlined by McKay & Marshall [2].

VI. Iterations of action research

A. Iteration 1: Pilot test with students without direct involvement by reseracher

The first and third iterations show that without personal involvement, or consulting if you will, people will not do requirements engineering. At this iteration two students took the time to do RE.

Because of the outcome of the first iteration was not satisfactory and new iteration was needed to be done so the plan needed to be amended based on the observations and feedback received from the students during this iteration.

The steps for the first iteration followed Figure 3.2 from the the start with "Research themes / interests / questions" to "amend plan & design if further explanation & research are required".

B. Iteration 2: Pilot test with students with direct involvement by researcher

At the second iteration at school I used personal involvement by contacting eleven students and they responded by testing the website and answering the questionnaire about their experience. The answers from the students showed that there was much to improve both with the platform and with the questionnaire. The platforms menu names were after this iteration changed to names that explained better what they were for and the language of the platform was changed to Swedish.

The questionnaire was improved by removing questions that were not of interest for the study and many duplicated question were removed for the third iteration. And the
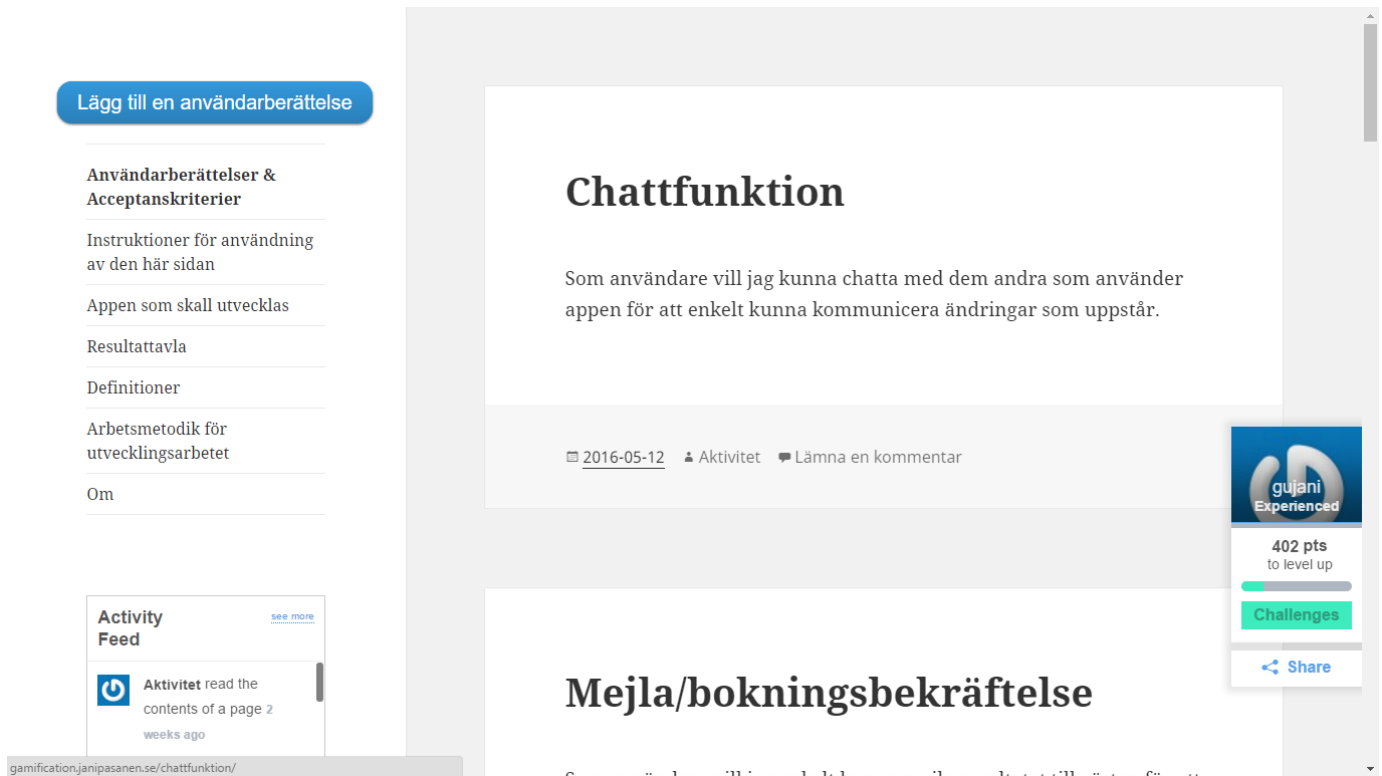
Figure 4: The front page of the platform with the menu to the left and the user stories in the middle
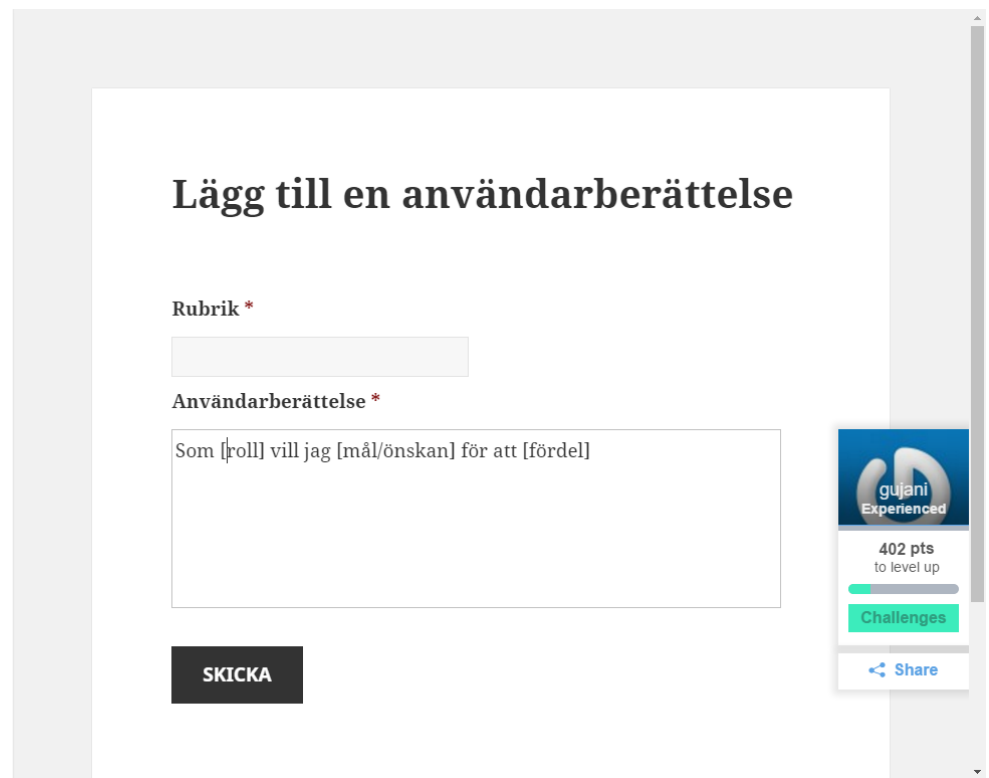
Figure 5: The user story entry page with the entry template in the free text field

questions were translated into Swedish and entered into a separate questionnaire for iteration 3.

C. Iteration 3: Conducting RE using gamification at the company with stakeholders without direct involvement by researcher

The third iteration that was conducted at the company and it showed the same thing as the first iteration, that without personal involvement, or consulting if you will, people will not do requirements engineering.

After the third iteration no stakeholders participated so I had to amend the plan again. We contacted the owner, the operations manager and the department head and ask them to get involved push for a meeting and a workshop were I would explain the task and show what to do and how.

D. Iteration 4: Conducting RE using gamification at the company with stakeholders with direct involvement by researcher

For the fourth iteration a workshop was held where I showed on the projector what I wanted them to do and how. At the end of the workshop some stakeholders tested the site, entered user stories, some entered also acceptance criteria and answered the questionnaire. Unfortunately all but one missed to press the "submit" button for the questionnaire. It was clear to me, after the follow up interview that was held after the fourth iteration, that despite the workshop and presentation, the stakeholders felt that the task was complicated and some heard the words user stories and acceptance criteria and decided "that this is too complicated". I did explain the meaning of these words and also showed the page in the website that had these explanations written in Swedish with the definition of them.

At the fourth iteration I got involved with the stakeholders at the company and as a consultant first held a workshop to practically show them what they should do and how they access the website, secondly get them to enter user stories and acceptance criteria and thirdly to answer the questionnaire intended for the third and fourth iteration at the company.

The data shows that the forms are useful and make the task easier. In particular for user stories. I noted that for most stakeholders with no previous experience of defining user stories and acceptance criteria they did not know, skipped to or forgot to write acceptance criteria for the user stories that they entered. In general all agreed that this task was difficult because even though it was explained I wanted them to define requirements for

the app in the form of "I as [role], want to do [task] to reach [goal]". Many got stuck on the terminologies, as for example the participant that answered "i don't know" to the question what effect the gamification elements in the web based gamified platform had on entering user stories and acceptance criteria. There were three other people who answered the same question and one noted that it is "smart" and the other noted that "it makes the website more fun to use".

From the first two iterations I got some very helpful comments from students about how to make the website better in forms of usability and ease of finding information.

E. Follow up interview

After having held a follow up interview with some of the stakeholders that wanted to give verbal feedback, it became clear that many of the stakeholders thought this task was difficult and that I did not explain it well enough. After receiving feedback from students in the second iteration I expected this from the stakeholders for Iteration 3 but not the fourth one. As an attempt to counter this for the third iteration I added the written instructions to the web based gamified platform so it, in my opinion, explained how to do, what to do, and what the scope for the user stories and acceptance criteria was. After the fourth iteration with the workshop I did not expect this kind of feedback.

F. Iteration 5: Workshop, group discussion & consensus decisions

The requirements will be noted down after group discussions and consensus decision and finally one person will convert the requirements to user stories and enter them into the platform. Looking at it in beforehand it seems that making it into a social activity where discussion and collaboration is encouraged might work best for getting the stakeholders to participate and be motivated to conduct RE.

VII. RESULTS

The results of the study were aimed to supply data for the analysis and discussion of the research questions. For the first two iterations of actions research, the questions in the questionnaire answered more than the research questions and as these additional questions made the questionnaire more cumbersome to answer they were removed for the third and fourth iterations that were conducted at Star Bowling.

The extra data gathered from students in the first and second iterations involved questions about the usability

of the web based platform, with Gamification elements and usability of it, besides the Gamification elements, thus making it possible to do analysis on more than just Gamification although those results are from students and not from the employees at the organisational partner. One has to have that in mind and remember that students have prior experience on RE.

This section outlines the gathered data where I separate the data from the questionnaires for the first and second iterations from the third and fourth iterations and do analysis of it and I also outline the data gathered from the interview.

A. Quantitative Data

In the questionnaire for the first two iterations I used a 1-7 scale and I interpreted 1 as strongly disagree, 2 moderately disagree, 3 slightly disagree and consequently 5 slightly agree, 6 moderately agree and 7 strongly agree. For the last two iterations a scale of 1-6 was used where the same interpretation was used as above, the only difference was that there was a neutral, middle answer. I made this change to force the responder to pick a side, either agree or not agree to the statement. A neutral answer, for me, does not say much other than that the responder did not make a decision.

Figure 6 shows that the web based gamified platform apparently made it easy to find relevant information, thus, we can largely rule out that bad usability affected the results.

The fact that having a template to follow when writing in user stories and acceptance criteria made it easier according to the students. Notable is that two thirds of the students moderately agreed that the template for user stories made writing easier for them while the remaining third, or 36%, agreed slightly. For the template for acceptance criteria two thirds slightly agreed and one third agreed moderately, while one student did neither disagree or agree that the template made it easier.

Figure 8 covers the Gamification related questions I asked the students, using the questionnaire, during iterations 1 & 2 of action research. Two out of eleven thought that the Gamification elements neither increased or decreased thanks to the gamified mechanism in the platform, while 63%, seven out of eleven, felt that their interaction increased slightly. One felt that the interaction increased moderately while one felt that the interaction increase a lot. The numbers are very similar when asked if Gamification elements motivated them to enter user stories, acceptance criteria and generally use the platform. One student strongly disagreed with the statement, one disagreed slightly, while 63%, seven students, slightly agreed with the statement and one moderately agreed. Three students agreed that they experienced the entering as a

competition between other participants, three students moderately disagreed with the statement, three students slightly disagreed with the statement and two neither disagreed or agreed with the statement.

In regards to the leaderboard one student strongly disagreed with the statements that it was useful for performing the task, two students slightly disagreed and similarly two students agreed slightly to it being useful, two students at both ends of the scale, three neither disagreed or agreed, one two agreed slightly, one moderately and one strongly. When looking at the more relevant questions about the leaderboard such as if the leaderboard motivated to perform the task and if the leaderboard made the task more fun a majority of the students felt that they were motivated slightly, while in terms of it making the task more fun there are equal amount of answers in both sides of the scale so 36% agreed slightly to moderately that the task was more fun thanks to the leaderboard while 27 % disagreed with the statement and 9%, one student disagreed strongly with the statement.

When looking at the same questions for the badges the numbers are clearly different, 9% strongly disagreed that the badges made the task more fun, 45% slightly agreed with the statement, 36% moderately agreed and 9%, one student, strongly agreed. A majority felt that the badges motivated them in doing the task, 90 % strongly agreed, 9%, one student, disagreed. A majority felt that the badges were useful for performing the task where 81 % slightly agreed with the statement and 18% strongly disagreeing.

Figure 7 shows that, of the eleven students that answered in Iterations 1 & 2, all of them felt that they had little to very little motivation of writing user stories or acceptance criteria and a majority felt that it was boring and had little interest to come up with and write them. A third of them where very little interested and yet two thirds of them thought that user stories and acceptance criteria as a way of gathering user requirements was slightly useful and a third of them felt that user stories and acceptance criteria was moderately useful.

Figure 9 shows answers from the key stakeholders to the questionnaire that was used in Iterations 3 & 4, and that three out of five stakeholders thought that it was slightly boring to come up with and write user stories and acceptance criteria, one thought that is moderately boring and one thought that it was slightly fun. Five of the stakeholders were motivated little to write user stories and acceptance criteria while one was slightly more motivated and one that was quite motivated, 2,3 and 4 in a 1-6 scale. A majority of the stakeholders think that user stories and acceptance criteria are slightly to very useful with only one stakeholder seeing them as useless.

When it comes to the gamification elements in the platform the majority of the stakeholders seemed to agree

The Platform – Heatmap for iterations 1 & 2		1	2	3	4	5	6	7	
Information was difficult to find in the platform	Strongly disagree	18,18%	45,45%	18,18%	9,09%	9,09%	0,00%	0,00%	Strongly agree
The platform was easy to use	Strongly disagree	0,00%	0,00%	18,18%	9,09%	18,18%	36,36%	18,18%	Strongly agree
The description in the business case page made the task more interesting	Strongly disagree	9,09%	27,27%	18,18%	45,45%	0,00%	0,00%	0,00%	Strongly agree
The description in the business case page gave the task a purpose	Strongly disagree	9,09%	18,18%	36,36%	9,09%	0,00%	18,18%	9,09%	Strongly agree
The purpose of the task decreased because of the description in the business case page	Strongly disagree	18,18%	27,27%	27,27%	27,27%	0,00%	0,00%	0,00%	Strongly agree
The description in the business case page increased my motivation for the task	Strongly disagree	18,18%	9,09%	27,27%	45,45%	0,00%	0,00%	0,00%	Strongly agree
The description increased my understanding of the task	Strongly disagree	9,09%	0,00%	0,00%	27,27%	27,27%	36,36%	0,00%	Strongly agree
The contents of the definitions page increased my understanding of the task	Strongly disagree	0,00%	27,27%	36,36%	9,09%	18,18%	9,09%	0,00%	Strongly agree
The contents of the definitions page made me more motivated for doing the task	Strongly disagree	18,18%	36,36%	27,27%	18,18%	0,00%	0,00%	0,00%	Strongly agree
The contents of definitions page was easy to understand	Strongly disagree	0,00%	0,00%	18,18%	9,09%	45,45%	18,18%	9,09%	Strongly agree
The content in the instructions page made this task easier	Strongly disagree	0,00%	0,00%	0,00%	9,09%	45,45%	36,36%	9,09%	Strongly agree
The contents in the instructions page motivated me	Strongly disagree	9,09%	9,09%	36,36%	36,36%	9,09%	0,00%	0,00%	Strongly agree
The contents in the instructions page made this task more interesting	Strongly disagree	18,18%	9,09%	45,45%	27,27%	0,00%	0,00%	0,00%	Strongly agree
The purpose of the task increased because of the instructions	Strongly disagree	9,09%	18,18%	36,36%	27,27%	9,09%	0,00%	0,00%	Strongly agree
The instructions increased my understanding of the task	Strongly disagree	0,00%	0,00%	27,27%	27,27%	36,36%	9,09%	0,00%	Strongly agree

Figure 6: Heatmap on the web based gamified platform specific questions for Iterations 1 & 2.

with the statement that they motivated them to enter user stories, acceptance criteria and generally use the platform. Two stakeholders slightly disagreed, while one moderately agreed and two strongly agreed.

They seemed to be motivated by the leaderboard, it seems that they thought it made the task more fun and they seemed to see it as useful for performing the task. Two stakeholders agree slightly that it makes the task more fun, while two agree moderately and one agreed strongly. Only one stakeholder disagreed slightly that the leaderboard motivated them, one agreed slightly, two agree moderately and one strongly. One disagree slightly with the leaderboard being useful in performing the task, two agree slightly, one agreed moderately and one agree strongly.

The feeling regarding the badges seem to be similar but the badges seem to be less useful for performing the task then the leaderboard. One stakeholder, disagreed slightly with that the badges made the task more fun, while one agreed slightly, two agreed moderately and one agreed strongly. One disagreed slightly that the badges motivated to perform the task, one agree slightly, two agreed moderately and one agreed strongly. Three stakeholder slightly disagreed that the badges were useful for performing the task and two stakeholders agreed slightly.

A majority of the stakeholders did not feel tense or pressured by doing the task and after having done the task one disagreed moderately that the task was interesting, one disagreed slightly, two agreed slightly and one strongly

Requriements engineering – Heatmap for iterations 1 & 2		1	2	3	4	5	6	7	
How much motivation did you feel regarding writing user stories and acceptance criteria?	Very little	27,27%	36,36%	36,36%	0,00%	0,00%	0,00%	0,00%	Very much
How interested were you in writing user stories and acceptance criteria?	Very little	36,36%	27,27%	27,27%	0,00%	9,09%	0,00%	0,00%	Very interested
What is your opinion on user stories and acceptance criteria?	Very useless	0,00%	0,00%	0,00%	0,00%	63,64%	36,36%	0,00%	Very useful
How fun is it to come up with and write user stories and acceptance criteria?	Very boring	18,18%	45,45%	18,18%	0,00%	0,00%	18,18%	0,00%	Very fun
The template for user stories made it easier to write them	Strongly disagree	0,00%	0,00%	0,00%	0,00%	36,36%	63,64%	0,00%	Strongly agree
The template for acceptance criteria made it easier to write them	Strongly disagree	0,00%	0,00%	0,00%	9,09%	63,64%	27,27%	0,00%	Strongly agree
How do you feel about the statement that comming up with and writing user stories and acceptance criteria take too much time?	Strongly disagree	0,00%	0,00%	9,09%	54,55%	18,18%	9,09%	9,09%	Strongly agree
I found the task very interesting	Strongly disagree	9,09%	45,45%	9,09%	18,18%	18,18%	0,00%	0,00%	Strongly agree
I felt tense while doing the task	Strongly disagree	18,18%	36,36%	27,27%	9,09%	9,09%	0,00%	0,00%	Strongly agree
Doing the task was fun	Strongly disagree	18,18%	27,27%	36,36%	0,00%	9,09%	9,09%	0,00%	Strongly agree
I felt pressure while doing the task	Strongly disagree	18,18%	36,36%	18,18%	27,27%	0,00%	0,00%	0,00%	Strongly agree
After working at this task for a while I felt competent	Strongly disagree	18,18%	9,09%	18,18%	45,45%	0,00%	9,09%	0,00%	Strongly agree

Figure 7: Heatmap on agile requirements engineering questions for iterations 1 & 2.

agreed.

B. Qualitative Data

In the questionnaires for all iterations there were free text fields included for answers. In the first two iterations there where comment fields for each part, the question where I asked the respondent how they would improve the web based gamified platform and in all iterations there was the question "What effect do the competitive nature of gaming elements have on requirements elicitation?" and "What effect do the gamification elements in the platform have on the elicitation of (come up with and write) user stories and acceptance criteria?".

What effect do the competitive nature of gamification elements have on requirements elicitation?

- "Not much. They don't really elicit anything, apart that they give slight motivation to do them, but does not make it easier. Points should be awarded for quality of requirements, not quantity"
- "Not sure if I understand the question"

- "Requirements written for points, not for producing good software."
- "the[re] was no competition."

The important thing to take away from this feedback is that some of the students did not feel that reward was given for the quality of requirements entered, but for entering something and some felt that reward was given for quantity and not quality.

What effect do the gamification elements in the platform have on the elicitation of user stories and acceptance criteria?

- "Not much. They don't really elicit anything, apart that they give slight motivation to do them, but does not make it easier"
- "The constant notifications are distracting."
- "The badges motivated me to enter more of them. That fact of getting feedback such as "Well done!" or "Good job!" every now and then gave me a feeling that I was doing something well."
- "The badges have a motivational effect. getting feed-

Gamification – Heatmap for iterations 1 & 2		1	2	3	4	5	6	7	
How much did your interaction with the gamified platform decrease or increase due to continuous feedback from the gamified mechanisms in the platform?	Strongly disagree	0,00%	0,00%	0,00%	18,18%	63,64%	9,09%	9,09%	Strongly agree
Gamification elements motivated you to enter user stories, acceptance criteria and generaly to use the platform	Strongly disagree	9,09%	0,00%	9,09%	9,09%	63,64%	9,09%	0,00%	Strongly agree
You experienced entering user stories and acceptance criteria as a competition between other participants	Strongly disagree	0,00%	27,27%	27,27%	18,18%	0,00%	9,09%	18,18%	Strongly agree
I found the leaderboard useful in performing the task	Strongly disagree	9,09%	0,00%	18,18%	36,36%	18,18%	9,09%	9,09%	Strongly agree
The leaderboard motivated me to perform the task	Strongly disagree	0,00%	0,00%	18,18%	36,36%	27,27%	9,09%	9,09%	Strongly agree
The leaderboard made this task more fun	Strongly disagree	9,09%	9,09%	18,18%	27,27%	18,18%	18,18%	0,00%	Strongly agree
The leaderboard made me feel more competent in doing the task	Strongly disagree	27,27%	27,27%	36,36%	9,09%	0,00%	0,00%	0,00%	Strongly agree
The badges made this task more fun	Strongly disagree	9,09%	0,00%	0,00%	0,00%	45,45%	36,36%	9,09%	Strongly agree
The badges made me feel more competent in doing the task	Strongly disagree	36,36%	9,09%	9,09%	27,27%	0,00%	18,18%	0,00%	Strongly agree
The badges made me feel less skilled in doing this task than other participants	Strongly disagree	36,36%	36,36%	9,09%	18,18%	0,00%	0,00%	0,00%	Strongly agree
The badges motivated me to perform the task	Strongly disagree	9,09%	0,00%	0,00%	0,00%	90,91%	0,00%	0,00%	Strongly agree
I found the bages to be useful in performing the task	Strongly disagree	18,18%	0,00%	0,00%	0,00%	81,82%	0,00%	0,00%	Strongly agree

Figure 8: Heatmap on Gamification questions for Iterations 1 & 2.

back that you did something good often gives a positive effect."

- "The element[s] do not have much effect on elicitation, however, the badges may increase the will to enter more user stories just to find out what other badges I mig[h]t get."
- "The gamification elements motivated me to enter one more user story just to see what would happen and what kind of badges I would get. I did not feel motivated to think about the quality of user stories that I entered."
- "The continuous feedback in the form of encouragement gave me a feeling of wanting to do more and the poin[t]s made me want to gather as much points as possible"
- "It was fun with feedback"
- "Smart"

C. Follow up interview after the fourth iteration of action research

After having held a follow up interview with some of the stakeholders that wanted to give verbal feedback, it became clear that many of the stakeholders thought this task was difficult and that I did not explain it well enough.

After receiving feedback from students after Iteration 2 I expected the task to be slightly difficult for the stakeholders at Star Bowling for Iteration 3 but not at Iteration 4 where I explained the task and showed what to do and how on the projector.

Because there were difficulties to understand the task at Iteration 2 I rewrote the instructions in the web based gamified platform for Iteration 3 so that it, in my opinion, explained clearly how to do, what to do, and what the scope for the user stories and acceptance criteria was. And after the fourth iteration with the workshop I did not expect this kind of feedback.

The responses to these follow up interviews show the stakeholders believe that collaboration will have positive

Gamification & Requriements Enginering – Heatmap for iterations 3 & 4		1	2	3	4	5	6	
How fun was it to come up with and write user stories and acceptance criteria?	Very boring	0,00%	20,00%	60,00%	20,00%	0,00%	0,00%	Very fun
How motivated were you regarding writing user stories and acceptance criteria?	Very little	0,00%	60,00%	20,00%	20,00%	0,00%	0,00%	Very much
What is your opinion on user stories and acceptance criteria	Very useless	0,00%	0,00%	20,00%	40,00%	20,00%	20,00%	Very useful
The template for user stories made it easier to write them	Strongly disagree	0,00%	0,00%	20,00%	0,00%	40,00%	0,00%	Strongly agree
The template for acceptance criteria made it easier to write them	Strongly disagree	0,00%	0,00%	20,00%	0,00%	40,00%	0,00%	Strongly agree
The gamification elements motivated you to enter user stories, acceptance criteria and generaly to use the platform	Strongly disagree	0,00%	0,00%	40,00%	0,00%	20,00%	40,00%	Strongly agree
The leaderboard made this task more fun	Strongly disagree	0,00%	0,00%	0,00%	40,00%	40,00%	20,00%	Strongly agree
The leaderboard motivated me to perform the task	Strongly disagree	0,00%	0,00%	20,00%	20,00%	40,00%	20,00%	Strongly agree
I found the leaderboard useful in performing the task	Strongly disagree	0,00%	0,00%	20,00%	40,00%	20,00%	20,00%	Strongly agree
The badges made this task more fun	Strongly disagree	0,00%	0,00%	20,00%	20,00%	40,00%	20,00%	Strongly agree
The badges motivated me to perform the task	Strongly disagree	0,00%	0,00%	20,00%	20,00%	40,00%	20,00%	Strongly agree
I found the bages to be useful in performing the task	Strongly disagree	0,00%	0,00%	60,00%	40,00%	0,00%	0,00%	Strongly agree
The interaction with the gamified platform increase thanks to continuous feedback from the gamified mechanisms in the platform?	Strongly disagree	0,00%	0,00%	40,00%	20,00%	40,00%	0,00%	Strongly agree
You experienced entering user stories and acceptance criteria as a competition between other participants	Strongly disagree	0,00%	20,00%	40,00%	20,00%	20,00%	0,00%	Strongly agree
How do you feel about the statement that comming up with and writing user stories and acceptance criteria take too much time?	Strongly disagree	0,00%	0,00%	60,00%	40,00%	0,00%	0,00%	Strongly agree
I felt tense while doing the task	Strongly disagree	20,00%	20,00%	40,00%	20,00%	0,00%	0,00%	Strongly agree
I found the task very interesting	Strongly disagree	0,00%	20,00%	20,00%	40,00%	0,00%	20,00%	Strongly agree
I felt pressure while doing the task	Strongly disagree	80,00%	0,00%	20,00%	0,00%	0,00%	0,00%	Strongly agree

Figure 9: Heatmap on the answers to the questions at the Star Bowling Iterations 3 & 4.

effect where stakeholders participation is secured and they are motivated by group work and consensus based decision making. One of the stakeholders mentioned that "Can't we have a group meeting where we discuss together about the requirements and then decide about what the requirements are and then one person can enter then into the website". Whereby a majority of the participating stakeholders nodded agreeingly.

So during the coming monthly meeting a fifth iteration of action research will be held, where the problem solution that will be attempted is a workshop with requirements brainstorming. The requirements that are elicited will be discussed in the group and consensus decision will be made on each requirement. One person will at the end take the elicited requirements, translate them into user stories and acceptance criteria and enter them into the web based gamified platform. The workshop will be concluded with a department party. The interviewed stakeholders believe this is the approach that will work for countering the stakeholders who are uncertain of what it is that I want from them.

VIII. Discussion

The following sections answers the research questions stated in the introduction, and discuss the results presented in result section. In this section the potential problems with applying Gamification into RE is further discussed, and whether any results presented in this study support those claims.

The desired result is increased stakeholder interest and participation. So the question is if gamification in RE increases stakeholders interest and participation in requirements engineering and elicitation of user stories and acceptance criteria.

A. Research Questions & Contribution

I have conducted research of applying gamification to requirements engineering and conducted four iterations of action research. I have verified that motivating and engaging stakeholders to participate is a problem not only within unit testing, as described by Arnarsson and Johanneson, but in very high degree within requirement engineering as well [9].

There were difficulties getting the stakeholders participation and interest for requirements engineering, so even if there was a web based gamified platform available with written instructions and also videos, it did not solve the problem of stakeholder participation or interest. Had the stakeholders been interested of participating they could have used the site to conduct RE whenever they had time and in that way solving the problem of availability which a third identified problem with stakeholders within RE.

The students and also the stakeholders at Star Bowling showed lack of interest and motivation to do RE. Without active pushing from owners, upper management and department head very little would have happened. Without participation and engagement from the stakeholders gamification would have no effect on RE.

I have further discovered that there is a need for research on how the quality of the information that is entered can be programmatically assessed and points be accordingly rewarded based on the quality level. Currently the stakeholders are rewarded for entering information but for the rewards the quality of the data, that is entered, is not considered.

1) RQ1: What effect does applying gamification to requirements engineering have on RE elicitation and validation?: Based on the result outlined in the previous section it is clear that none of the students or stakeholders thought that the task itself was interesting, fun or motivating but all seem to agree that user stories and acceptance criteria are important way communicating the stakeholders requirements for a system that is to be developed.

The results show that once the stakeholders participation was secured they thought that gamification made RE entering more fun. The stakeholders at Star Bowling particularly liked the leaderboard while the badges did not have as much positive effect. And so, indirectly gamification has the same effect on RE elicitation since it is to think through the routines of the work that is done and what functionality needs to be in a system to support those routines.

Notable are also the comments from the students about the gamification elements in the platform which, according to the students, do not motivate or give positive feedback for quality RE. The question is how one would create the gamification element, the program or the algorithm that would automatically give the respondent rewards based on the quality of the information that is entered.

2) RQ2: What effect do competitive gamification elements have on RE elicitation: A majority, approximately 60 % of the students that responded to the first questionnaire, during Iterations 1 & 2, and the stakeholders at Star Bowling felt that the task of entering user stories and acceptance criteria was not a competition between colleagues or between students. The remaining 40 % did not elicit or enter more user stories, even if they saw the task as a competition, due to lack of interest and motivation.

Intervention from upper management was necessary to get a meeting with half of the employees of the affected department and a workshop where I acted as the consultant, explaining and showed on the projector to the stakeholders what they need to do, where in the web based gamified platform they should do it and what to fill in and be available for questions while they did the task. This

workshop was the fourth iteration of action research at Star Bowling.

The final solution for the requirements engineering at Star Bowling will be to arrange a workshop and department party in connection with the monthly meeting, this will be the fifth iteration of action research as outlined in section 5.

During Iterations 1 & 2, the students entered one user story per person and likewise for the stakeholders at Star Bowling, none entered more of them so for this paper the results of the conducted research are inconclusive whether or not the competitive gaming elements have an effect on RE elicitation, however, I can speculate.

The fact that a majority of the stakeholders at Star Bowling thought that the leaderboard made the task slightly more fun and motivated them slightly I would speculate that they liked to use it to see the standings and this could mean that had the workshop at Star Bowling been arranged as a competition between stakeholders where there would have been a prices, each stakeholder had their own login to the web based gamified platform and an own computer to enter user stories and acceptance criteria into the platform this could have motivated the stakeholders to enter more data. But this is for future research.

The question is if it would have been quality user stories and acceptance criteria or not. Perhaps one could have had a requirement for the competition that the entered information must be proper user stories and acceptance criteria following the given templates. The way the workshop was done for this research during the fourth iteration is outline in section 5.

B. Results related to previous work

According to the responses a majority of the stakeholders think that gamification generally influences RE practices positively and so it indirectly influences elicitation or validation. Meaning that the act of entering or writing them down is positively motivated by feedback and points and, so is consequently the cognitive act of thinking and figuring out what the requirements are so that they can be entered and, consequently, that the user can receive more points and feedback. And this aligns to some degree with the findings of Lombriser et al. who state in their discussion section that productivity, quality and creativity may be increased by gamification. [7].

They further discuss that, for the experiment that was conducted using gamification for RE, collaboration in elicitation may have negative consequences in the form of the collaboration absorbing peoples attention and blocking their productivity [7], however, the follow up interview after Iteration 4, see Section 6, shows that case is different at Star Bowling, where the stakeholders believe that collaboration will have the opposite effect where stakeholders participation is secured and they are motivated by the group work in the form of a workshop and consensus based decision making.

I found that the big challenge is getting stakeholders to participate in and be motivated about conducting RE. Before stakeholders participate gamification does not give any effect for RE and Johanneson and Ivarsson found the same thing. They applied gamification to unit testing and they identified two obstacles, stakeholders lack of motivation to do unit testing and lack of interest in software testing processes [10].

When searching for previous work on gamification with requirements engineering I have not found a paper that proposes solutions for rewarding the stakeholder based on the quality of the requirement that is entered so this is a gap, a weakness, that is yet to be researched.

C. Future work

Further studies in whatever form need to be made in the field of gamification for requirements engineering. The studies that have been done so far have consisted of too small amount of subjects to be able to make conclusive conclusions. At this point many of the questions can only be answered by speculation.

A RE competition should be arranged and afterwards the participants should be interviewed to document their experience of the competition and what effect the competitive environment had for their elicitation of requirements. This could also be conducted in the form of an experiment with two groups, the treatment group and the control group.

The question of how to programmatically determine the quality of entered data should be researched. The data could be user stories, acceptance criteria, unit test and so on.

D. Validity threats

This section covers validity threats based on the definition of validity threats for experiments provided by Wohlin et al. [17].

Conclusion validity Threats to conclusion validity are considered to be under control as the conclusion that I have made either have also been made by other researchers that have research gamification in RE or gamificaiton in other areas, and by the data gathered from the students and the stakeholders.

Internal validity The fact that we used action research as the methodology for this study is a threat to validity as the methodology is considered by some as nothing more than

consultancy with supposed lack of scientific rigour and discipline. Practical work applied while the research part is lacking. However I have followed the dual cycle process of action research as defined by McKay and Marshall and outline in section 5. I have taken into consideration the research process, both practical and research processes of action research should result in new knowledge and the results and discussion sections, 6 & 7 show this [2].

Fernandes et al. concluded in their study that the user interface had an impact on user satisfaction so to avoid the same mistake I opted to use a lean wordpress template for the front end of the platform. The page should be as clean as possible and information should be easy to find. [5].

There is a risk with competitive environments that there could be a rivalry and this could lead to lack of motivation.

There is also a risk of not understanding the task correctly so the person would not do the task out of fear of answering incorrectly and being embarrassed about it when everyone found out that the person did not understand the task correctly and answered wrong.

External validity The amount of students and stakeholders that participated was low. Eleven students in iterations one & two, and six stakeholders in iterations three & four of action research, as outline in section 5. That means that there is not a big enough sample of data to be able to draw definite conclusions, so the results on the effect of gamification and the competitive gaming elements have on requirements elicitation are inconclusive. I am forced to speculate.

The use of students in the first two iterations is a threat to validity but it is compensated by the fact that a majority of them were third year bachelor students and also by the fact that for iterations three & four were conducted with the stakeholders at Star Bowling.

IX. Conclusion

I have conducted research of applying gamification to requirements engineering and conducted four iterations of action research. I have verified that motivating and engaging stakeholders to participate is a problem not only within unit testing, as described by Arnarsson and Johanneson, but in very high degree within requirement engineering as well [9].

The were difficulties getting the stakeholders participation and interest for requirements engineering, so even if there was a web based gamified platform available with written instructions and also videos, it did not solve the problem of stakeholder participation or interest. Had the stakeholders been interested of participating they could have used the site to conduct RE whenever they had time and in that

way solved the problem of availability which is a third identified problem with stakeholders within RE.

The students and also the stakeholders at Star Bowling showed lack of interest and motivation to do RE. Without active pushing from owners, upper management and department head very little would have happened. Without participation and engagement from the stakeholders gamification would not have had any effect on RE.

I have further discovered that there is a need for research on how the quality of the information that is entered can be programmatically assessed and points be accordingly rewarded based on the quality level. Currently the stakeholders are rewarded for entering information but the rewards do not take into consideration the quality of the data that is entered.

Based on the results that where gathered it is clear that none of the students or stakeholders thought that the task itself was interesting, fun or motivating but all seem to agree that user stories and acceptance criteria are important way communicating the stakeholders requirements for a system that is to be developed.

The results show that once the stakeholders participation was secured they thought that gamification made RE entering more fun. The stakeholders at Star Bowling particularly liked the leaderboard while the badges did not have as much positive effect. And so, indirectly gamification has the same effect on RE elicitation and validation since it is to think through the routines of the work that is done and what functionality needs to be in a system to support those routines.

Notable are also the comments from the students about the gamification elements in the platform which, according to the students, do not motivate or give positive feedback for quality RE. The question is how one would create the gamification element, the program or the algorithm that would programmatically give the respondent rewards based on the quality of the information that is entered.

It is not possible to draw any conclusions on what effect competitive gaming elements had on RE elicitation because there was no competition between the stakeholder, however I can speculate what the effect could be. The fact that a majority of the stakeholders at Star Bowling thought that the leaderboard made the task more fun and motivated them means that they liked to use it to see the standings. This could mean that had the workshop at Star Bowling been arranged as a competition between stakeholders where there would have been prices, each stakeholder had their own login to the web based gamified platform and an own computer to enter user stories and acceptance criteria into the platform I believe this would have motivated the stakeholders to enter more data.

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A
Pilot questionnaire

This is the pilot questionaire that was used on students and for iterations 1 and 2.

Gamification for gathering user stories and acceptance criteria

The purpose of this questionaire is to gather data to be used for investigating what effect gamification and competitive gaming elements has to requirements engineering.

After filling in user stories and acceptance criteria to the gamified platform gamification.janipasanen.se please answer the following questions.

*Obligatorisk

1. **What is your age?** *
   Markera endast en oval.

   ◯ 18-23
   ◯ 23-25
   ◯ 25-30
   ◯ 30-40
   ◯ 40 or older

2. **Do you have prior experience of conducting requirements engineering and thinking in terms of user stories and acceptance criteria?** *
   Markera endast en oval.

   ◯ Yes
   ◯ No

Before introduction to the task of writing user stories and acceptance criteria

3. **How much motivation did you feel regarding writing user stories and acceptance criteria?** *
   Markera endast en oval.

	1	2	3	4	5	6	7	
Very little	◯	◯	◯	◯	◯	◯	◯	Very much

4. **What is your opinion on user stories and acceptance criteria?** *
   Markera endast en oval.

	1	2	3	4	5	6	7	
Very useless	◯	◯	◯	◯	◯	◯	◯	Very useful

After conducting the task of writing user stories and

acceptance criteria

The platform in general

5. **The template for user stories made it easier to write them**
   Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

6. **The template for acceptance criteria made it easier to write them**
   Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

7. **How interested were you in writing user stories and acceptance criteria? ***
   Markera endast en oval.

	1	2	3	4	5	6	7	
Very little	◯	◯	◯	◯	◯	◯	◯	Very interested

8. **How fun is it to come up with and write user stories and acceptance criteria? ***
   Markera endast en oval.

	1	2	3	4	5	6	7	
Very boring	◯	◯	◯	◯	◯	◯	◯	Very fun

9. **How do you feel about the statement that comming up with and writing user stories and acceptance criteria take too much time? ***
   Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

10. **I did not feel at all nervous about doing the task ***
    Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

11. **I found the task very interesting** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

12. **I felt tense while doing the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

13. **I think I did well at this activity compared to other participants** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

14. **Doing the task was fun** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

15. **I felt pressure while doing the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

16. **After working at this task for a while I felt competent** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

17. **Information was difficult to find in the platform** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

18. **The platform was easy to use** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

19. **Comments on the answers on the platform in general**

....

....

....

....

....

Improvement of the platform/website

20. **What would you do to improve the platform/website?** *

....

....

....

....

....

21. **Gamification elements motivated you to enter user stories, acceptance criteria and generaly to use the platform** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

22. **What effect do the competitive nature of gaming elements have on requirements elicitation?** *

....

....

....

....

....

23. **How much did your interaction with the gamified platform decrease or increase due to continuous feedback from the gamified mechanisms in the platform?** *
Markera endast en oval.

	1	2	3	4	5	6	7	
Decreassed a lot	◯	◯	◯	◯	◯	◯	◯	Increased a lot

24. **You experienced entering user stories and acceptance criteria as a competition between other participants** *
Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly agree	◯	◯	◯	◯	◯	◯	◯	Strongly disagree

Gamification elements in the platform

The Leaderboard

25. **I found the leaderboard useful in performing the task** *
Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

26. **The leaderboard motivated me to perform the task** *
Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

27. **The leaderboard made this task more fun** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

28. **The leaderboard didn't make me stressed** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

29. **The leaderboard made me feel pressured while doing the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

30. **The leaderboard made me feel more competent in doing the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

31. **Comments regarding the leaderboard**

....

....

....

....

....

Gamification elements in the platform

Badges

32. **The badges didn't make me feel stressed** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

33. **The badges made this task more fun** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

34. **The badges made me feel pressured while doing the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

35. **The badges made me feel more competent in doing the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

36. **The badges made me feel less skilled in doing this task than other participants** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

37. **The badges motivated me to perform the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

38. **I found the bages to be useful in performing the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

39. **Comments to the badges**

Elements in the platform

The Busines Case page with description of the context

40. **The description in the business case page made the task more interesting** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

41. **The description in the business case page gave the task a purpose** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

42. **The purpose of the task decreased because of the description in the business case page** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

43. **The description in the business case page increased my motivation for the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

44. **The description increased my understanding of the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

45. **Comment on the description page**

....

....

....

....

....

Elements in the platform

The definitions page

46. **The contents of the definitions page increased my understanding of the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

47. **The contents of the definitions page made me more motivated for doing the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

48. **The contents of the definitions page made me more interested of the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

49. **The contents of definitions page was easy to understand** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

50. **Comments on the definitions page and its contents**

....

....

....

....

....

Elements of the platform

The instruction page and its content

51. **The content in the instructions page made this task easier** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

52. **The contents in the instructions page motivated me** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Strongly agree

53. **The contents in the instructions page made this task more interesting** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

54. **The purpose of the task increased because of the instructions** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

55. **The instructions increased my understanding of the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

56. **Comments on the instructions page**

....

....

....

....

....

Improvement of this questionaire

57. **What effect do the gamification elements in the platform have on the elicitation of (come up with and write) user stories and acceptance criteria?** *

....

....

....

....

....

58. **What would you do to improve this questionaire?** *

....

....

....

....

....

Thank you for your participation!

B

Questionnaire that was used at the company - Swedish

These are the Swedish questions that were used on the stakeholders at Star Bowling. These questions are in english in Appendix C.

Spelifiering vid insamling av användarberättelser och acceptanskriterier

Syftet med formuläret är att samla in data för att kunna undersöka om spelifiering, gamification, motiverarar och engagerar intressenter att delta, att interagera mer med en platform, att svara med fler användarberättelser och acceptanskriterier och med mer kvalitet än vid vanlig kravhantering.

Efter att ha fyllt i användarberättelser och acceptanskriterirer i spelifieringsplatformen vänligen svara på nedanstående frågor.

1. **Hur gammal är du?** *
   Markera endast en oval.

   ◯ 18-22

   ◯ 23-25

   ◯ 26-30

   ◯ 30-40

   ◯ 41-50

   ◯ 50 eller äldre

2. **Har du tidigare hört talas om användarberättelser och acceptanskriterier?** *
   Markera endast en oval.

   ◯ Ja

   ◯ Nej

Innan introduktionen till uppgiften

3. **Hur motiverad var du att skriva användarberättelser och acceptanskriterier?** *
   Markera endast en oval.

	1	2	3	4	5	6	
Väldigt lite	◯	◯	◯	◯	◯	◯	Väldigt mycket

4. **Vad är din åsikt om användarberättelser och acceptanskriterier som kravspecifikation?** *
   Markera endast en oval.

	1	2	3	4	5	6	
Väldigt onyttig	◯	◯	◯	◯	◯	◯	Väldigt nyttigt

Efter att ha skrivit användarberättelser och acceptanskriterier

5. **Mallen för användarberättelser gjorde det enklare att skriva dem** *
Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

6. **Mallen för acceptanskriterier gjorde det enklare att skriva dem**
Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

7. **Spelelementen motiverade dig att komma på och skriva in användarberättelser, acceptanskriterier och i övrigt använda webbsidan** *
Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

Spelelement i webbsidan

Poängutdelning och poängtavlan

8. **Poängutdelning och poängtavlan gjorde den här uppgiften roligare** *
Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

9. **Poängutdelning och poängtavlan motiverade dig att utföra uppgiften** *
Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

10. **Poängtavlan var användbar för att utföra uppgiften** *

Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

11. **Märkena gjorde den här uppgiften roligare** *

Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

12. **Märkena motiverade dig med att utföra uppgiften** *

Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

13. **Märkena var användbara för att utföra den här uppgiften** *

Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

Generella frågor om uppgiften

14. **Hur roligt är det att komma på och att skriva användarberättelser och acceptans kriterier?** *

Markera endast en oval.

	1	2	3	4	5	6	
Väldigt tråkigt	◯	◯	◯	◯	◯	◯	Väldigt roligt

15. **Interaktion med webbsidan ökade tack vare kontinuerlig återkoppling från spelifierings elementen/mekanismerna i webbsidan** *

Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

16. **Du upplevde ifyllandet som en tävling mellan andra deltagare** *

Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

17. **Håller du med om att det tar för lång tid att komma på användarberättelser och acceptanskriterier?** *

Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

18. **Du kände dig spänd av att utföra uppgiften** *

Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

19. **Du tyckte att uppgiften var väldigt intressant** *

Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

20. **Du kände dig stressad när du utförde uppgiften** *

Markera endast en oval.

	1	2	3	4	5	6	
Instämmer inte alls	◯	◯	◯	◯	◯	◯	Instämmer helt och hållet

21. **Kommentarer**

....

....

....

....

....

22. **Vilken effekt tyckte du spelifieringselementen hade för uppgiften att komma på och skriva in användarberättelser och acceptanskriterier?** *

....

....

....

....

....

23. **Ange er mejladress om det går bra att kontakta er med uppföljningsfrågor**

....

Tack för Ert deltagande!

C

The questions in English of the questionnaire that was used at the company

The questions that were used on the stakeholders Star Bowling translated to English. These questions that were asked of the stakeholders are in Appendix B.

Gamification for gathering user stories and acceptance criteria

The purpose of this questionaire is to gather data to be used for investigating what effect gamification and competitive gaming elements has to requirements engineering.

After filling in user stories and acceptance criteria to the gamified platform gamification.janipasanen.se please answer the following questions.

1. **What is your age?** *
   Markera endast en oval.

   ◯ 18-22
   ◯ 23-25
   ◯ 26-30
   ◯ 30-40
   ◯ 41 or older

2. **Do you have prior experience of conducting requirements engineering and thinking in terms of user stories and acceptance criteria?** *
   Markera endast en oval.

   ◯ Yes
   ◯ No

Before introduction to the task of writing user stories and acceptance criteria

3. **How motivated were you regarding writing user stories and acceptance criteria?** *
   Markera endast en oval.

	1	2	3	4	5	6	
Very little	◯	◯	◯	◯	◯	◯	Very much

4. **What is your opinion on user stories and acceptance criteria** *
   Markera endast en oval.

	1	2	3	4	5	6	
Very useless	◯	◯	◯	◯	◯	◯	Very useful

After conducting the task of writing user stories and

acceptance criteria

The platform in general

5. **The template for user stories made it easier to write them**
   Markera endast en oval.

	1	2	3	4	5	6	
Strongly disagree	◯	◯	◯	◯	◯	◯	Strongly agree

6. **The template for acceptance criteria made it easier to write them**
   Markera endast en oval.

	1	2	3	4	5	6	
Strongly disagree	◯	◯	◯	◯	◯	◯	Strongly agree

7. **The Gaming elements motivated you to enter user stories, acceptance criteria and generaly to use the platform** *
   Markera endast en oval.

	1	2	3	4	5	6	
Strongly disagree	◯	◯	◯	◯	◯	◯	Strongly agree

Game elements in the website

8. **The leaderboard made this task more fun** *
   Markera endast en oval.

	1	2	3	4	5	6	
Strongly disagree	◯	◯	◯	◯	◯	◯	Strongly agree

9. **The leaderboard motivated me to perform the task** *
   Markera endast en oval.

	1	2	3	4	5	6	
Strongly disagree	◯	◯	◯	◯	◯	◯	Strongly agree

10. **I found the leaderboard useful in performing the task** *
    Markera endast en oval.

	1	2	3	4	5	6	
Strongly disagree	◯	◯	◯	◯	◯	◯	Strongly agree

11. **The badges made this task more fun** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

12. **The badges motivated me to perform the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

13. **I found the bages to be useful in performing the task** *

Markera endast en oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

General questions about the task

14. **How fun was it to come up with and write user stories and acceptance criteria?** *

Markera endast en oval.

	1	2	3	4	5	6	
Very boring	◯	◯	◯	◯	◯	◯	Very fun

15. **The interaction with the gamified platform increase thanks to continuous feedback from the gamified mechanisms in the platform?** *

Markera endast en oval.

	1	2	3	4	5	6	
Strongly disagree	◯	◯	◯	◯	◯	◯	Strongly agree

16. **You experienced entering user stories and acceptance criteria as a competition between other participants** *

Markera endast en oval.

	1	2	3	4	5	6	
Strongly agree	◯	◯	◯	◯	◯	◯	Strongly disagree

17. **How do you feel about the statement that comming up with and writing user stories and acceptance criteria take too much time?** *

Markera endast en oval.

	1	2	3	4	5	6	
Strongly disagree	◯	◯	◯	◯	◯	◯	Strongly agree

18. **I felt tense while doing the task** *

Markera endast en oval.

	1	2	3	4	5	6	
Strongly disagree	◯	◯	◯	◯	◯	◯	Strongly agree

19. **I found the task very interesting** *

Markera endast en oval.

	1	2	3	4	5	6	
Strongly disagree	◯	◯	◯	◯	◯	◯	Strongly agree

20. **I felt pressure while doing the task** *

Markera endast en oval.

	1	2	3	4	5	6	
Strongly disagree	◯	◯	◯	◯	◯	◯	Strongly agree

21. **What effect do you think the gamification elements in the platform have on the elicitation of (come up with and write) user stories and acceptance criteria?** *

22. **Specify your email address if it is alright to contact you with follow-up questions**

Thank you for your participation!