# Abstract

Winning or losing a game session is the final consequence of a series of decisions and actions made during the game. The analysis and understanding of events, mistakes, and flows of a concrete game play may be useful for different reasons: understanding problems of gameplay, data mining of specific situations, and even understanding educational aspects in serious games. Mistakes made by players may result in failure to complete the game objectives. These mistakes, which are usually difficult to spot or to reproduce in subsequent trials, directly jeopardize the learning capabilities of serious games. In order to solve this issue we introduce a novel approach based on provenance concepts to model and represent a game flow. We model the game data and map it to provenance, generating a provenance graph, used for analysis. As a proof of concept, we also instantiated our proposed framework and graph generation in a Software Engineering game, allowing players to identify their mistakes and learn through them by analyzing the generated provenance graph from collected gameplay data.

Keywords: Game flow, analysis, player behavior, data logging, gameplay, provenance, graph.

# Resumo

Ganhar ou perder uma sessão de jogo é a consequência final de uma série de decisões e ações feitas durante o jogo. A análise e compreensão dos eventos, erros, e os fluxos de um jogo concreto pode ser útil por diversos motivos: compreender os problemas de jogabilidade, mineirar dados de situações específicas e até mesmo entender os aspectos educacionais em jogos sérios. Erros cometidos pelos jogadores podem resultar em falha para completar os objetivos do jogo. Estes erros, que normalmente são difíceis de detectar ou reproduzir em sessões subsequentes, prejudicam diretamente a capacidade de aprendizagem dos jogos sérios. Para resolver esta questão, apresentamos uma nova abordagem baseada em conceitos de proveniência a fim de modelar e representar um fluxo de jogo. Desta forma, os dados do jogo são modelados e mapeados para proveniência, a fim de gerar um grafo proveniência que é utilizado para análise. Como prova de conceito, a abordagem proposta e a geração do grafo foram instanciadas em um jogo de Engenharia de Software, permitindo jogadores identificarem seus erros e aprenderem com eles, através de analises no grafo de proveniência gerado a partir de dados coletados do jogo.

Palavras-chaves: fluxo de jogo, analise, comportamento de jogadores, registro de dados, gameplay, proveniência, grafo.

# – Introduction

## Motivation

A game session is composed of a series of decisions and actions that were made throughout the game. In many situations, analyzing and understanding the events, mistakes, and flows of a concrete gameplay[[1]](#footnote-1) experience, known as game flow analysis, may be useful for understanding the achieved results from the session. Game flow analysis may be also fundamental for detecting symptoms of problems that occurred due to wrong decision-making or even bad gameplay design. This type of analysis may be subjective when there is no formalized process. Furthermore, depending on the game dynamics and its complexity, it would require playing the game successively by making the same decisions to intuitively guess which ones were responsible for generating the observed outcomes. Therefore, reproducing the same state can be unviable due to the difficulty of generating the same game state in order to identify, in a trial and error approach, the source of a problem. In addition, examining the game flow allows the identification of good and bad attitudes made by players.

Game flow analysis techniques involve two phases: data logging and visualization. The data logging phase is responsible for collecting gameplay information during a gaming session to be used in the visualization phase. The visualization phase displays the gathered gameplay information in the form of graphics and graphs for analysis. Developers and gam designers use these graphs to study certain aspects of the game, providing insights about player behavior or game issues.

Therefore, almost all AAA[[2]](#footnote-2) game titles have some form of game development telemetry (GDT) due to the importance of game flow analysis (ZOELLER, 2010). According to ZOELLER[[3]](#footnote-3) (2010), GDT is an “*automatic measurement and transmission of data from game executable, build pipeline and development tools for recording, analysis, and workflow improvement*”. GDTs are mainly used by the game industry to analyze gameplay data to understand the customer’s experiences in the game, to identify post launch issues, and to understand the market for future games releases (ZOELLER, 2010).

Researches focusing on game flow analysis and game telemetry are becoming important because game development is a new industry and the game industry is still learning new ways to improve their games. However, the main usage of existing approaches for a game flow analysis is to improve quality assurance (QA) and game testing[[4]](#footnote-4). Common approaches involve gathering information about player behavior (DIXIT; YOUNGBLOOD, 2008; HOOBLER *et al.*, 2004; LIU *et al.*, 2011; WALLNER, 2013), statistical data mining (AMBINDER, 2009; ROMERO, 2008; THOMPSON, CLIVE, 2007; ZOELLER, 2010), and aiding during the playtesting[[5]](#footnote-5) phase (DANKOFF, 2011; ZOELLER, 2010).

All these approaches are developer-oriented, which means that the game analysis is done by developers to improve their games. However, we believe that players can also directly benefit from game flow analysis by understanding how the game reacted to their actions and decisions. Existing approaches for this purpose, such as the replay of a game session, only show explicit influences. For example, in a replay of a racing game, it is possible to identify only shallow reasons, such as that the car rolled over from tight turns or collided with a fence. However, other deeper reasons may involve the car’s tire pressure or suspension tuning, which can be customized by the player. These other possible reasons are difficult to visually identify when watching a replay and can be unnoticeable to less experienced players.

Therefore, this work main motivation is to facilitate player’s understanding about how events emerged during the game session and how each action influenced the outcomes. This knowledge can be used in future game sessions to avoid making the same mistakes or even to adjust gameplay features.

## Goals

Given the aforementioned motivation, the aim of this work is to present a new approach for game flow analysis. The goal is to improve the player’s understanding of the game flow, providing insights on how the story progressed and the influences on the outcomes. In order to improve understanding, this work provides the means for analyzing the game flow by using provenance. Provenance analysis is done by processing collected gameplay data and generating a provenance graph, which relates the actions and events that occurred during the game session. This provenance graph allows the player to identify critical actions that influenced the game outcome and helps to understand how events were generated and which decisions influenced them. This process may also aid in the identification of mistakes, allowing the player to reflect upon them for future interactions.

Thus, this work proposes a conceptual framework that collects information during a game session and maps it to provenance terms, using digital provenance (FREIRE *et al.*, 2008) concepts for representing the game flow. The conceptual framework provides the means for game flow analysis by using and manipulating a provenance graph that represent the gathered game information.

Even though the scenario used in this work is over a serious game, we believe that the concepts discussed here are applicable to any kind of game and are useful to support advanced game flow analysis, such as gameplay design, gameplay balancing, gameplay metrics, data mining, and even for storytelling.

## Research Questions

Our approach and its evaluation have as main objective to answer the following research questions:

* Does provenance analysis help to understand events that emerged during a game session?
* Is provenance analysis faster than only watching a replay of the game session?
* Is provenance analysis more accurate than only watching a replay of the game session?

## Contributions

This work introduces new perspectives on game flow analysis, to a level where the game provenance can produce and consolidate knowledge. This knowledge can help on confirming the hypotheses formulated by players on how events affected the game, supporting tutors for a better guidance when applied in a serious game, and extracting behavior patterns from individual sessions or groups of sessions. The provenance gathering also opens new research possibilities for behavior pattern data mining, provenance in storytelling, detecting gameplay design issues, gameplay metrics, and gameplay refinement and balance.

The provenance visualization can occur both on-the-fly or in post-mortem sessions. It allows for the discovery of issues that contributed to specific game flows and results achieved throughout the gaming session. This analysis can be used on games to improve understanding of the game flow and identifying actions that influenced the outcome, aiding the player to understand why they happened the way they did. It can also be used to analyze a game story development, how it was generated, and which events affected it. Currently, we do not make inferences to the user, but let the user decide what he wants to infer. Studies in this area can be made in order to identify information that can be automatically omitted from the user without affecting the overall analysis.

## Organization

This work is organized in six other chapters, beside this introduction. Chapter 2 outlines part of the knowledge base necessary for understanding this work. It presents existing usages of game flow analysis, ranging from gameplay data logging to game analysis in the game industry. Then, it describes known approaches for gameplay data logging and gameplay data visualization.

Chapter 3 outlines another part of the necessary knowledge base for this work. It describes concepts of provenance in order to gather historical information about objects for further analysis. It also presents the existing provenance models (OPM and PROV) that can be used for provenance of digital information. Lastly, it presents a comparison between models, pointing out their similarities.

The proposed conceptual framework is presented at Chapter 4, denominated as *provenance in games*. This chapter describes how the gameplay data is gathered and structured to be used in a provenance graph. Then, it outlines rules to interpret the gathered data for the generation of the provenance graph. Lastly, it describes some features to distinguish information in the graph and to aid in the analysis.

Chapter 5 presents the materialization of the conceptual framework presented at Chapter 4, encompassing both the collection and visualization phases. It provides an overview of a serious game named SDM, describing the game and how the gameplay data is gathered. It also outlines implementation details for the provenance graph visualization tool developed in this work. Furthermore, it introduces a guiding example, which is the same game session used at Chapter 6 during the experiment. Lastly, it shows details about generating the provenance graph from the gathered information, graph representations, and analysis features available at the developed tool over the guiding example.

After describing the approach and the graph visualization tool, the next chapter, Chapter 6, describes the evaluation performed on the usage of provenance analysis to understand game events. The planning and execution of the experiments are detailed, indicating how we obtained and processed the data for the assessment. The results are analyzed through hypothesis testing. Finally, it presents some threats to validity of the experiments.

Finally, Chapter 7 concludes this work, listing contributions, limitations, and future work.

# – Conclusion

## Contributions

This work introduced a new approach for gameplay data logging and visualization, entitled *provenance in games*. This approach collects gameplay information from executed actions and events records related information, including the characters involved, those that were affected by the action or event, and the generated influences. It also records game states for each entity (characters and objects) and the influences that changed their states. After the completion of the gaming session, the collected information, denominated as *game flow log*, is exported to an external provenance graph visualization tool: *Prov Viewer*. The *game flow log* contains provenance information from the gaming session and is used by *Prov Viewer* to plot the game’s provenance graph.

The provenance graph allows post game analysis to discover issues that contributed to specific game flows and results achieved throughout the game session. This analysis can be used to improve understanding of the game flow and to identify actions that influenced the outcome, aiding the player to understand why they happened the way they did. It can also be used to analyze the game story development, how it was generated, and which events affected it.

*Prov Viewer* uses graphic features to distinguish information for faster comprehension of the events. These features affect the displayed graph by transforming vertices and edges, changing their shapes and color according to the information type. Another important feature present is the information filter, which omit displayed information that is not relevant for the analysis. This filtering is important for analysis because it reduces the amount of displayed information to only those desired to be seen by the user. This allows for faster identification of the influences in the game, which is possible due the way the provenance graph is structured.

Both precision and agility were evaluated by an experiment where volunteers watched a game session and answered a questionnaire containing specific questions about certain events that occurred in the game. Half the volunteers in the experiment had access to the provenance graph while the other half had only access to the replay. As a result, we could conclude that in the experiment context the usage of provenance graph for analysis provided faster and more precise answers when determining the reasons of outcomes in a game, in comparison with watching a replay of the game session.

While the main application of provenance in this work is over a serious game and is used to assist players in understanding how events affected the story, we believe that the concepts discussed here are applicable to other kinds of games and useful to support advanced forms of analysis. These concepts may be useful for gameplay balancing and design, data mining of behaviors, storytelling, gameplay metrics, and aiding developers by detecting gameplay issues.

These features from the provenance in games approach are at Table 1, which is an extension, adding our approach, of Table Y from Section 2.6 from Chapter 2.

Table 1: Comparative chart among approaches

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | GVM | TRUE | Playtracer | Play-Graph | Provenance in Games |
| Graph |  |  | X | X | X |
| Graphic | X | X |  |  |  |
| State Machine |  | ? | X | X | X |
| Data logging | X | X | ? | ? | X |
| Event Context |  | X |  |  | X |
| Player Behavior | ? | X | X | X | X |
| Actions |  | X |  | X | X |
| Statistical data mining | X | X | X | X | X |
| Developer-Oriented | X | X | X | X | X |
| Player-Oriented |  |  |  |  | X |

**Legend**:

The “X” indicates the approach has the specified characteristic.

The “?” indicates unspecified information from documented sources.

**Graphs**: Indicates if the approach uses graph to represent information.

**Graphics**: Indicates if the approach explicitly uses graphical charts to represent information.

**State Machine**: Indicates if the approach display states transitions.

**Data Logging**: Indicates if the approach includes the data logging process.

**Event Context**: Indicates if the approach gathers contextual information from events and actions.

**Player Behavior**: Indicates if the approach can analyze player behaviors.

**Actions**: Indicates if the approach collects the actions performed in the game, instead of only collecting the action’s outcomes.

**Statistical data mining**: Indicates if the information gathered and/or displayed by the approach can be used for statistical mining (gameplay metrics).

**Developer-Oriented**: Indicates if the approach can be used for playtesting.

**Player-Oriented**: Indicates if the approach can be used by players in order to better understand the game flow.

## Limitations

One limitation of the current version of *Prov Viewer* is related to scalability, regarding processing performance. Algorithms in *Prov Viewer* are not optimized for manipulating a graph with thousands vertices and edges. Thus, its performance may degrade when dealing with such graph sizes.

Another current limitation is related to inferences, which *Prov Viewer* does not automatically make. All inferences must be done by the user. This might cause visualizations problems at a first glance due to the size of the graphs at their full extension, overwhelming the user. However *Prov Viewer* supports inference and provides the necessary features for implementing automatic filters and clustering.

Currently, *Prov Viewer* is not compatible with other provenance applications due to the input file format. The current input format uses a text-based structure exported by SDM. Nevertheless, it can be adapted for known formats, such as XML, by modifying how *Prov Viewer* reads a file.

## Future Work

After developing the conceptual framework for data logging and analysis, along with *Prov Viewer*, it is possible to describe new research possibilities for the proposed approach. The following paragraphs describe possible researches and improvements in the *provenance in games* conceptual framework and in the *Prov Viewer* provenance graph visualization tool.

A possible improvement in the visualization tool is related with accessibility, by making *Prov Viewer* less context sensitive, allowing the user to customize filters (edge filters and attribute status visualization) without the need of hard coding it in the application. For example, we could allow the user to provide a configuration file that specifies the type of each filter. Thus, this would make *Prov Viewer* compatible with other games or provenance applications without the need of tinkering with the source code.

Another improvement is related to *Prov Viewer’s* input file format. Currently, the *game flow log* is a tab separated value text file. However, there are plans to modify the structure to use some semi-structured format such as JSON or XML for greater compatibility with other applications. Thus, it would allow *Prov Viewer* to be more accessible by other applications due to the usage of a well known semi-structured format.

One hypothesis for greatly improving accessibility for *Prov Viewer* would be in creating an extension for existing game engines (i.e., Unity3D). This extension, when enabled, would automatically capture gameplay information when executing events by using the *provenance in games* conceptual framework. Thus, it would be possible to generate a *game flow log* without the need of changing the game’s source code.

One of the current draw-backs of *Prov Viewer* is related to inferences. Currently, it does not automatically make inferences to the user, but let the user or developers decide what needs to be inferred. However, we provide the necessary tools to create inference rules, like filters and collapses (both for vertices and edges). Studies in this area can be made in order to identify information that can be omitted from the user without affecting the overall analysis, while at the same time not being context dependable. Thus it would provide generic inferences rules that could be used in any game.

Another area to be worked upon is related to the graph visualization scalability. Depending on the game style, a game session might take several hours to complete, or even days in case of RPGs. This makes the size of the provenance graph to be overwhelming to the user, even when removing unnecessary information during the generation of the *game flow log* to reduce the log size. One way to avoid such situations is to show the provenance graph with some filters selected instead of its full extension. For example, before showing the graph to the user, it is possible to use collapses to reduce the graph’s size. Combats can be identified and collapsed into a single vertex for each instance. Places visited in the game can also be collapsed into a single vertex, containing all interactions made in that location, even combats. It is also possible to have collapses inside collapses. In this case, a collapsed combat inside a collapsed area visited by the player may contain other actions aside from the combat, such as interactions with the ambient. This gives an impression of a map from the player’s journey, showing vertices for each location visited by the player, while allowing the player to expand only the situations he desires to analyze. It is similar to *google maps*, where it shows the entire world and allows the user to zoom into specific locations. However in this case, it shows instances of the journey taken by the player.

It is also possible to go beyond that by using automatic inferences algorithms. Instead of collapsing all combats and locations, inference algorithms could decide which combats or locations were not relevant to the story, or had no noticeable impact in the player’s journey, while keeping important events visible to the player. This is possible because provenance is analyzed from the present to the past. This way, combats’ outcomes are known and can be used to decide if they are relevant or not. If the player was victorious with minor challenge, did not suffer severe wounds, or barely used any resources at his disposal, then the entire combat can be simplified into just one vertex, representing the combat with the enemy. However, if the combat was challenging or the player lost, it is interesting to display all actions in it for analysis, allowing the player to identify important facts that influenced the combat outcome.

Although the proposed approach was used for assisting players to understand game events, it can also be used to open new researches in the field of behavior patterns data mining, gameplay design, detection of gameplay issues, and adjustment of gameplay features. It might also be possible to modify the proposed approach to use artificial intelligence algorithms. These algorithms would gather gameplay information, according to its perception limitations (if any), and analyze the provenance of the information in order to improve its performance and adapt through experiences.

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# Appendix A

**Formulário de Consentimento**

**Estudo**

Este estudo visa avaliar o quanto as técnicas de Proveniência em Jogos, apresentadas através de um cenário de jogo do SDM, são beneficentes para o aprendizado, tanto para um aluno experiente quanto para um aluno novo no assunto.

**Idade**

Eu declaro ter mais de 18 anos de idade e concordar em participar de um estudo conduzido por *Troy Costa Kohwalter* da Universidade Federal Fluminense.

**Procedimento**

Este estudo acontecerá em uma única sessão, que incluirá a apresentação de um vídeo do jogo SDM, documentos auxiliares para o entendimento do procedimento, um questionário, e em alguns casos a utilização da ferramenta *Proof Viewer*. Eu entendo que, uma vez que o experimento tenha terminado, os trabalhos que desenvolvi serão estudados visando entender a eficácia do modelo proposto.

**Confidencialidade**

Toda informação coletada neste estudo é confidencial, e meu nome não será divulgado. Da mesma forma, me comprometo a não comunicar os meus resultados enquanto não terminar o estudo, bem como manter sigilo das técnicas e documentos apresentados e que fazem parte do experimento.

**Benefícios e liberdade de desistência**

Eu entendo que os benefícios que receberei deste estudo são limitados ao aprendizado do material que é distribuído e apresentado. Eu entendo que sou livre para realizar perguntas a qualquer momento ou solicitar que qualquer informação relacionada à minha pessoa não seja incluída no estudo. Eu entendo que participo de livre e espontânea vontade com o único intuito de contribuir para o avanço e desenvolvimento de técnicas de ensino para a Engenharia de Software.

**Pesquisador responsável**

Troy Costa Kohwalter

Instituto de Computação – Universidade Federal Fluminense (UFF)

**Professores responsáveis (Orientadores)**

Prof Leonardo Gresta Paulino Murta

Instituto de Computação – Universidade Federal Fluminense (UFF)

Prof Esteban W. Gonzalez Clua

Instituto de Computação – Universidade Federal Fluminense (UFF)

**Nome:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Assinatura: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Data:\_\_\_/\_\_\_/\_\_\_**

**Este formulário está dividido Formulário de Consentimento, Questionário de Caracterização e um Questionário de Conteúdo.**

**Desde já, agradecemos a sua disponibilidade.**

# Appendix B

**Questionário de Caracterização do participante**

1. Formação Acadêmica

( ) Doutorado

( ) Doutorando

( ) Mestrado

( ) Mestrando

( ) Graduação

( ) Graduando

Ano de ingresso: \_\_\_\_\_\_\_\_ Ano de conclusão (ou previsão de conclusão): \_\_\_\_\_\_\_\_\_

1. Formação Geral
   1. Qual é sua experiência em Engenharia de Software? (marque aqueles itens que melhor se aplicam)

( ) Nunca aprendi Engenharia de Software.

( ) Já li material sobre Engenharia de Software.

( ) Estou fazendo uma disciplina sobre Engenharia de Software.

( ) Já fiz uma disciplina de Engenharia de Software.

( ) Dou aula de Engenharia de Software.

**Results:**

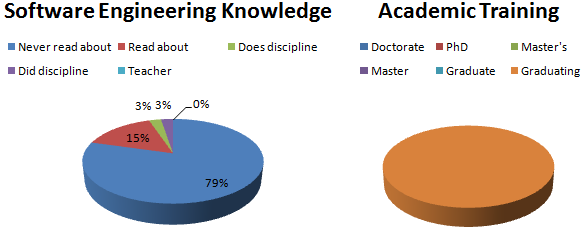


Figure 1: Volunteer’s characterization results

# Appendix C

**Experimento piloto: Questionário de Avaliação do Conteúdo**

1. Hora de inicio: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Utilizou o *Proof Viewer*?

( ) Sim.

( ) Não.

1. Considerando que nos dias três e quatro, o funcionário Urias exerceu a mesma tarefa (Elicitação sem protótipo), por que seu desempenho foi quase um terço (1/3) no dia quatro em comparação ao dia três?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Descreva os motivos que levaram a funcionária Emmy pedir demissão no dia 15.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Identifique a semana com o maior índice de produtividade. Aponte os fatores que levaram essa conclusão.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Identifique a semana com menor índice de produtividade. Aponte os fatores que levaram essa conclusão.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Identifique os fatores que levaram a demissão de diversos funcionários durante a quinta e sexta semanas (dias 26 a 34).

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Identifique os fatores mais contribuintes que levaram a falta de Creditos apresentada na quarta semana (dias 20 a 26).

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Hora de término: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Experimento piloto: Questionário de Avaliação do Conteúdo**

**Gabarito**

**(Resposta similar ou com mesmo sentido/significado é considerado correto)**

1. Hora de inicio: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Utilizou o *Proof Viewer*?

( ) Sim.

( ) Não.

1. Considerando que nos dias três e quatro, o funcionário Urias exerceu a mesma tarefa (Elicitação sem protótipo), por que seu desempenho foi quase um terço (1/3) no dia quatro em comparação ao dia três?

Por causa da influencia negativa da Edda

1. Descreva os motivos que levaram a funcionária Emmy pedir demissão no dia 15.

Horas extras decrementaram a estamina e consequentemente o moral

1. Identifique a semana com o maior índice de produtividade. Aponte os fatores que levaram essa conclusão.

Semana 3 (dias 14-20). Alteração da carga horária de 8 para 16 horas diárias

1. Identifique a semana com menor índice de produtividade. Aponte os fatores que levaram essa conclusão.

Semana 5 (dias 28-34). Estamina e Moral baixos. Iniciou a semana com metade da equipe por causa de pedidos de demissão

1. Identifique os fatores que levaram a demissão de diversos funcionários durante a quinta e sexta semanas (dias 26 a 34).

Moral baixa por causa de horas extras e falta de pagamentos nos dias 23 a 28

1. Identifique os fatores mais contribuintes que levaram a falta de Creditos apresentada na quarta semana (dias 20 a 26).

Horas extras dobraram as despesas e as contratações iniciais

1. Hora de término: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Appendix D

**Experimento: Questionário de Avaliação do Conteúdo**

1. Hora de inicio: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Utilizou o *Proof Viewer*?

( ) Sim.

( ) Não.

1. Qual foi o motivo responsável pela redução do moral do funcionário *Arden* que consequentemente levou a seu pedido de demissão?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Qual foi o motivo responsável pela redução do moral do funcionário *Daniel* que consequentemente levou a seu pedido de demissão?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Por que nos dias 9, 10, e 11 o funcionário *Tornik* não obteve progresso na sua função de *elicitação* (não teve aumento nos requisitos de cliente)?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Por que nos dias 10 e 11 o rendimento de Daniel na sua função de *especificação* teve uma discrepância muito grande (342 *validation* vs 34 *validation*)?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Mesmo entregando o projeto com *bugs* não encontrados/corrigidos, qual foi o maior fator contribuinte que permitiu entregar o projeto a tempo?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Identifique os dois fatores mais contribuintes que levaram a falta de Creditos apresentada a partir do dia 11.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Um funcionário ficou sem nenhuma tarefa durante quatro dias. Quem foi esse funcionário?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Hora de término: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Se tiver alguma sugestão, escreva no verso. Obrigado.

**Experimento: Questionário de Avaliação do Conteúdo**

**Gabarito**

**(Resposta similar ou com mesmo sentido/significado é considerado correto)**

1. Hora de inicio: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Utilizou o *Proof Viewer*?

( ) Sim.

( ) Não.

1. Qual foi o motivo responsável pela redução do moral do funcionário *Arden* que consequentemente levou a seu pedido de demissão?

Falta de pagamentos

1. Qual foi o motivo responsável pela redução do moral do funcionário *Daniel* que consequentemente levou a seu pedido de demissão?

Exaustão por horas extras

1. Por que nos dias 9, 10, e 11 o funcionário *Tornik* não obteve progresso na sua função de *elicitação* (não teve aumento nos requisitos de cliente)?

“Fez elicitação através de revisão de requisitos” ou “Falta de protótipos”

1. Por que nos dias 10 e 11 o rendimento de Daniel na sua função de *especificação* teve uma discrepância muito grande (342 *validation* vs 34 *validation*)?

Influencia negativa

1. Mesmo entregando o projeto com *bugs* não encontrados/corrigidos, qual foi o maior fator contribuinte que permitiu entregar o projeto a tempo?

Negociação por mais tempo (estender deadline)

1. Identifique os dois fatores mais contribuintes que levaram a falta de Creditos apresentada a partir do dia 11.

Contratação e treinamento

1. Um funcionário ficou sem nenhuma tarefa durante quatro dias. Quem foi esse funcionário?

Arden

1. Hora de término: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Se tiver alguma sugestão, escreva no verso. Obrigado.

1. Gameplay is defined as “the total experience provided by a game’s structure and mechanics” (THOMPSON, JIM *et al.*, 2007). [↑](#footnote-ref-1)
2. AAA or triple-A game is a game developed by a large studio and funded by massive budget (SCHULTZ, 2006). [↑](#footnote-ref-2)
3. Georg Zoeller is the Lead Technical Designer for BioWare Austin. [↑](#footnote-ref-3)
4. Game testing is a software testing process for detecting defects, also known as bugs, in the game and is directly related to quality control in games (BATES, 2004). [↑](#footnote-ref-4)
5. Playtesting is the process of exposing the game, before its release, to the intended audience in order to find bugs and design flaws (ISBISTER, 2008). Playtesting differs from QA testing because it does not use professional testers, but actual players. It can be run as an open (commonly known as Beta Test in games) or closed playtesting (commonly known as Alpha Test in games). [↑](#footnote-ref-5)