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An Adventure Serious Game for

timation in Software Engineering

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Agenda

- Introduction
- Related work
- Back to Penelope Serious Game Design
- Evaluation of Back to Penelope
- Conclusions and future work



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Software development is not a rose road.



Introduction

 Estimation (Effortt / Cost) is one of the key factors involved in the failure of software development projects.





Introduction





Introduction

• Incorrect planning can be produced by:

Lack of expertise in the planning process

> Unrealistic assumptions and expectations



Lack of a systematic measurement process



Introduction

• Effort estimation capability is one of the main aspects that must be properly learned by software engineers.





Introduction

• Traditional classes are effective to introduce measurement estimation concepts.

• However, they are not effective in motivating students or allowing them to put the knowledge learned into practice.





• The use of games has been of help for teaching by offering to the students learning environments without risks.



IWSM MENSURA



• By implementing serious games, it is possible to motivate and entertain students by modifying their behavior in a positive manner when coping with measurement estimation concepts.



IWSM MENSURA



 Contribution: the design a serious game developed to teach effort estimation using the COSMIC Function Points measuring method applied to conceptual models.



http://backtopenelope.me

IWSM MENSU



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Related Work

There are several systematic reviews (SLRs) about serious games published.





Related Work

Systematic Mapping Review of Literature

What evidence about serious games in the field of teaching/learning time or effort estimation exists ?







Related Work

Inclusion

- 1. The paper is written in English or Spanish.
- 2. The paper is about serious games oriented to effort or time estimation

Exclusion

1. The paper is related to effort or time estimation for development of serious games.

2. The paper is related to effort or time estimation only, without a serious game.

3. The paper is related to serious game design or implementation only, without presenting an approach for learning estimation.

4. Grey literature

5. Papers duplicated



Related Work

• Results obtained from the execution of the search string.

Library Name	Search Date	Search result	Candidate Studies	Selected Papers
IEEEXplore	21-01-18	1152	5	2
ACM Digital Library	21-01-18	217	3	1
Springer Link	21-01-18	123	3	2
(Snowballing)	09-03-18	7	5	5

Total 10 papers



Related Work



20% for students learning



Related Work

Paper Title	Game Name	Game Type	Learning Scope	Game Design	Val	EE
Coverage of the ISO 21500 Standard in the Context of Software Project Management by a Simulation-Based Serious Game	ProDec	Simulation	Software Project Management	-	No	yes
Coverage of ISO/IEC 29110 Project Management Process of Basic Profile by a Serious Game	ProDec	Simulation	Software Project Management	-	No	yes
Integrating serious games as learning resources in a software project management course: the case of <i>ProDec</i>	ProDec	Simulation	Software Project Management	-	yes	No
Simulation in software	SESAM	Simulation	Software	Models	yes	yes
Challenges and issues in the development of a Software Engineering simulation game	SPIAL	Simulation, Role playing	Software Process Improvement	Models	No	No
Engendering an Empathy for Software Engineering	SimjavaSP	Simulation, Role Playing	Software Project Management	Models	yes	No
AMEISE – A Media Education Initiative for Software Engineering Concepts, the Environment and Initial Experiences	AMEISE	Simulation, Multiplayer, Competition	Software Project Management	Models	No	No
Model Driven Game Development: Experience and Model Enhancements in Software Project Management Education	The Incredible Manager	Simulation, Role Playing	Software Project Management	Models	No	No
A Simulation-Based Game for Project Management Experiential Learning	The Incredible Manager	Simulation, Role Playing	Software Project Management	Models	No	No
A Game for Taking Requirements Engineering More Seriously	Software Quantum Game	Simulation	Requirement Engineering	Models	No	No



Related Work



Students to estimate the effort of a set of pre-defined tasks.



Effort estimation from expertise of developers.

• The other approaches do not consider effort estimation tasks, or indeed the effort is already predefined by the system without intervention of the player (student) in the estimation process.



Related Work

We didn't find approaches that present novel gaming scenarios or a story thread that differs from software engineering tasks, which could better motivate the use of the game as a complementary learning technique for measurement.



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Design of Back To Penelope

Unity game development engine, which uses C# as scripting language.

• It allows to develop games for different platforms, such as Windows, OSx, Linux, iOS, or Android operating systems .





Design of Back To Penelope

• Conceptual framework of the MDA (Mechanics, Dynamics and Aesthetics)





Game proposal







Game Focus

 Back to Penelope videogame helps in the learning process of effort estimation through the application of the COSMIC measurement method.

 In each of the *Back to Penelope* scenes, the player has challenges that correspond to tasks to be implemented starting from one or more class diagrams.

Game Context

In *Back to Penelope*, the player must take the role of *Ada*, a young girl astronaut on an exploration mission of a new solar system as part of the *Odyssey* project, whose mission is to find new planets.

Game Context

 Ada travels in a recognition spaceship that is designed to travel large distances among planets; however, it is not designed to land on or launch from a planet itself since it does not have enough power to break the eventual planet gravity.

Game Context

 Ada is orbiting the planet Omicron-IV, when her ship is trapped by the gravity causing Ada to force land.

Then, she is trapped by the high gravity. This forces Ada to fix her ship in order to return to her mothers ip, which is named *Penelope*.

 To fix the ship, she must use the *disposable Utilities Droids* (dUD), which require the indication of the functional size of each task that needs to be accomplished.



BTP - Mechanics

 The game has two mechanics: to measure the COSMIC functional size of a system, and to correct a measurement performed



Beatriz Marín, Oscar Pastor, Alain Abran : Towards an accurate functional size measurement procedure for conceptual models in an MDA environment. Data Knowl. Eng 69 (5): 472-490 (2010)



BTP - Mechanics

 Each scene presents support systems that must be implemented for fixing the spaceship. These systems are represented by class models.

• The player must assign a dUD to each class.

• The player must estimate the corresponding size for the class to be implemented.



BTP Mechanichs

• The selected dUD will be in a working state. We convert the CFP to time considering the constant: 1 CFP corresponds to 3 seconds of implementation time for a dUD.

• The game provides a tutorial to learn how to perform an estimation by using COSMIC.



BTP - Dynamics

• Main menu / Scene selection







BTP - Dynamics

• Game play view and Class diagram







BTP - Aesthetics

• Narrative of the game. We create a fantasy story (the player is Ada) to motivate engineering students.

• A time bar for each scene.

• Different difficulty levels in the class diagram of each scene.

 Feedback that is given to the player when the implementation of a class has been under- or overestimated.





BTP - Aesthetics

Example difficulty levels





Demo BTP

Demo_BTP Scene 1

Demo_BTP Scene 2

Demo_BTP Scene 3

Demo_BTP Scene 4



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BTP evaluation

• Exploratory empirical study: usability and effectiveness.

• Number of tries that are necessary by a player to perform a correct estimation.



BTP evaluation

• UMUX questionaire

Perceived Effectiveness	Does <i>Back to Penelope</i> allow you to learn how to estimate by using the COSMIC method?
Perceived Satisfaction	Is playing <i>Back to Penelope</i> a frustrating experience?
General vision	Is Back to Penelope easy to use?
Perceived Efficiency	Do you spend too much time making corrections with <i>Back to Penelope</i> ?





First BTP evaluation

• 10 students graduate from the Engineering major of Information Technology and Telecommunications.

- Brief explanation
- Questionnaire
- Effectiveness was not evaluated.







Results of first BTP evaluation

 70% of the players is agreed or totally agreed with the fact that Back to Penelope allowed them to learn how to the estimate by using the COSMIC method .





Results of first BTP evaluation

• 90% of the players showed a tendency to not feel frustrated when using the game.





Results of first BTP evaluation

• 80% of the players agreed or totally agreed that *Back to Penelope* was easy to use.





Results of first BTP evaluation

• 80% of the players disagreed they spent too much time making corrections with *Back to Penelope*.







Second BTP evaluation

- 30 students that passed the Software Engineering course
 - Brief explanation
 - COSMIC
 - Questionnaire



Voluntary







Second BTP evaluation

 Only 27% of the players agreed to register the time that they spent on each scene, and we cannot use it in the analysis about playing time.







Efficiency evaluation

• Passing from one scene to another takes a few minutes for the player.

Group	Scene 1	Scene 2	Scene 3	Scene 4
Group 1	85.8	142.2	136.8	197.0
Group 2	98.2	179.1		
Average	92.0	160.7	136.8	197.0



Effectiveness evaluation

• Student estimations were higher than the real value, with an average of 9.5% over the real value.

Group	Scene 1	Scene 2	Scene 3	Scene 4
Group 1	39.0	92.0	94.0	120.0
Group 2	31.5	96.7		
Average	35.3	94.3	94.0	120.0
Real Value	34.0	91.0	97.0	102.0

Students estimated the functional size of the class diagrams with adequate accuracy even though this is the first time that they used the COSMIC method.





Perceived Effectiveness

• 70% of the students answered that they use the maximum number of tries needed to perform a correct estimation.



10% of students perceived that they were ineffective.

Haarlem - Netherlands





Usabiliy Evaluation

• Players agreed that *Back To Penelope* allows them to learn to estimate using COSMIC.





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Conclusions

• Effort estimation is of paramount importance for planning the development of software projects.

 Measurement methods are needed to properly understand and plan SE projects.

Novel teaching techniques are required, specially for SE.



Conclusions

• BTP was designed in order to provide a playful experience to learn COSMIC measurment method.

- **BTP** is available for download at
- <u>http://backtopenelope.me</u>



Conclusions

 An exploratory empirical study has been performed to verify the perception of students with respect of this new method of teaching/learning in Software Engineering.

• Results indicate that **BTP** provides **benefits** for learning measument estimation with COSMIC.

ISM MENSU



Conclusions

- Limitations:
 - Lack of evidence of the Efficiency of BTP in the learning process.

Future work is referred to conduct experiments to evaluate the F-measure of BTP and to add more measurement methods to the game.





An Adventure Serious Game for Teaching Effort Estimation in Software Engineering

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