

Learning analytics in serious gaming:
uncovering the hidden treasury of game log files

Wim Westera

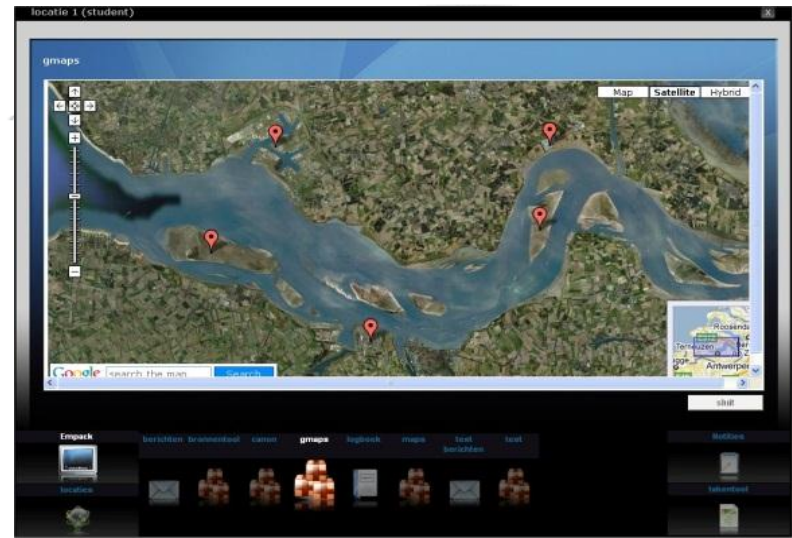
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Centre for Learning Sciences and Technologies
celstec.org



Environmental consultancy game

- MSc Environmental Science
- OUNL and Utrecht University
- Analysis, stakeholders, law, science, policy, politics
- 50 hours study load
- Student cohort 2008, 2009, 2010, 2011
- Total students: 118



Research questions

- Can we identify different gaming behaviours?
- If so, can behaviours be predictors of the final marks (exams)?
- Can pre-test scores be predictors of final marks??



Overview

- Why game logging?
- Our logging data
- Data analysis and interpretation
- Conclusions



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Why game logging?

- Conform to the Learning Analytics hype!
- Debugging, tracing bottlenecks
- Player-centered game design
- Personalised learning
- Adaptive gameplay (challenges and difficulty level)
- Tailored support for learning
(e.g. scaffolding, hints, microfeedback, meta-level feedback)



Progression versus logging

Progression triggers

- Static set of criteria/checklist
- Closures/Levels
- Milestones
- Score, speed, ...
- Performance-outcome oriented (what)

Performance

Logging

- Semantics
- Full history of actions
- Personal development
- Process-oriented (what, when and how)

Learning



The fallacy of performance¹

Performance attitude ↔ Learning attitude

- Milestones
 - Scores
 - Speed/ time constraints
 - Error and risk reduction
- Reflection
 - Repetition
 - Self-evaluation
 - Pauzes
 - Making mistakes

¹Fisher & Ford (1998)



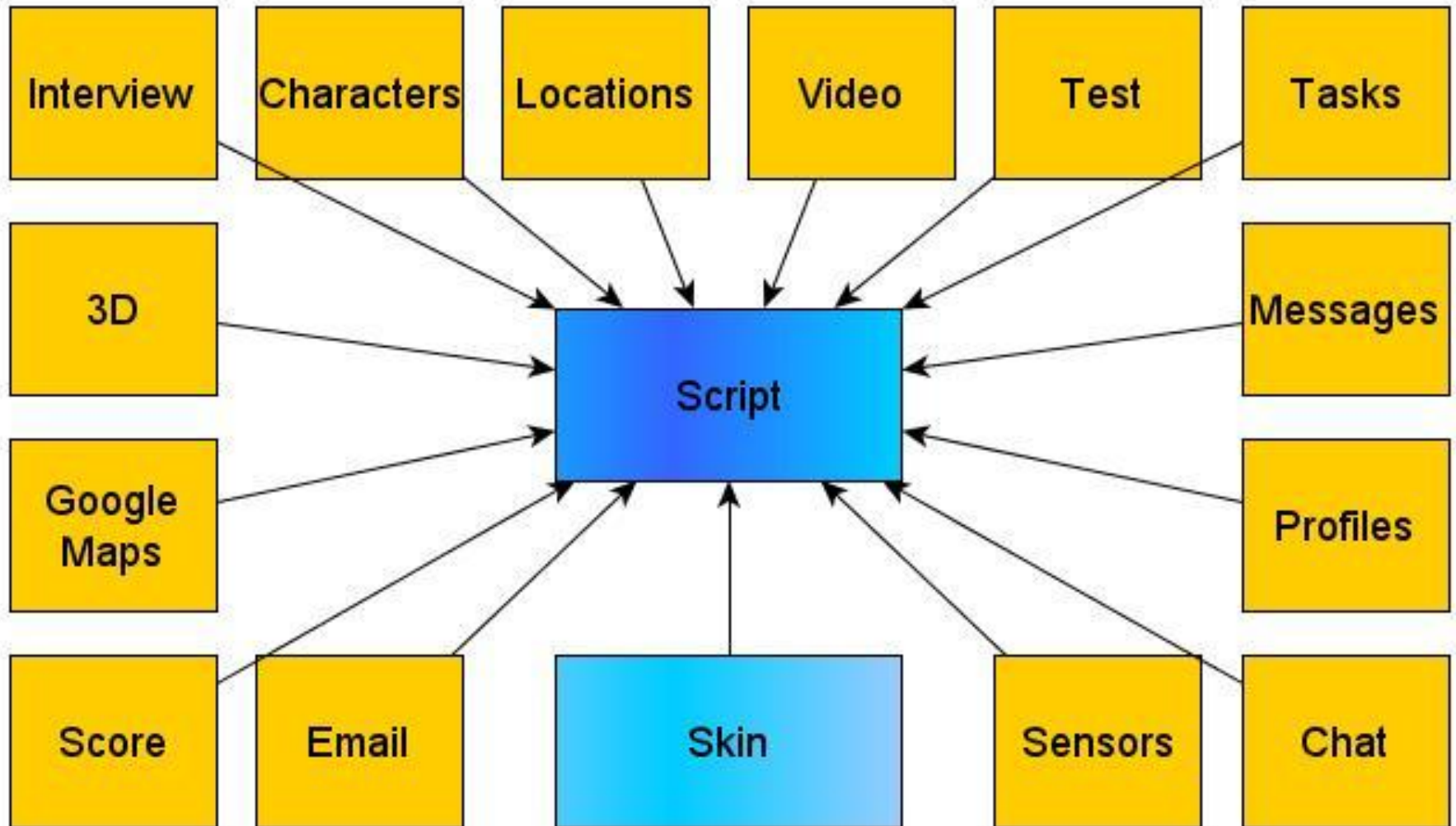
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Toolkit EMERGO.cc



The aggregated log file

name	time	component	tag	id	key	value	system/user	userdata	data
Student XXX	21436	script Windenergie	timer	TI_Start Deeltoets 2	finished	true	system	none	none
Student XXX	21439	gesprekken	map	theoretisch kader en onderzoekmethode	unfolded	true	user	none	none
Student XXX	21454	gesprekken	question	Vanuit welk theoretisch perspectief op belei	opened	true	user	none	none
Student XXX	21454	gesprekken	question	Vanuit welk theoretisch perspectief op belei	unfoldable	true	system	none	none
Student XXX	21454	gesprekken	question	Vanuit welk theoretisch perspectief op belei	selected	true	user	none	none
Student XXX	21454	gesprekken	fragment	OGB-WND-SAG-INT-006	opened	true	system	none	OGB-WND-SAG-INT-006.flv
Student XXX	21457	script Windenergie	timer	TI_Start Deeltoets 2	finished	true	system	none	none
Student XXX	21463	gesprekken	question	Welke methoden of modellen heb je in dit o	opened	true	user	none	none
Student XXX	21463	gesprekken	question	Welke methoden of modellen heb je in dit o	unfoldable	true	system	none	none
Student XXX	21463	gesprekken	question	Welke methoden of modellen heb je in dit o	selected	true	user	none	none
Student XXX	21472	gesprekken	question	Was de toepassing van de methoden en mod	opened	true	user	none	none
Student XXX	21472	gesprekken	question	Was de toepassing van de methoden en mod	unfoldable	true	system	none	none
Student XXX	21472	gesprekken	question	Was de toepassing van de methoden en mod	selected	true	user	none	none
Student XXX	21472	gesprekken	fragment	OGB-WND-SAG-INT-009	opened	true	system	none	OGB-WND-SAG-INT-009.flv
Student XXX	21475	gesprekken	question	Heb je zelf een nieuwe methode of methodi	opened	true	user	none	none
Student XXX	21475	gesprekken	question	Heb je zelf een nieuwe methode of methodi	unfoldable	true	system	none	none
Student XXX	21475	gesprekken	question	Heb je zelf een nieuwe methode of methodi	selected	true	user	none	none
Student XXX	21475	gesprekken	fragment	OGB-WND-SAG-INT-010	opened	true	system	none	OGB-WND-SAG-INT-010.flv
Student XXX	21478	gesprekken	component	component	opened	false	system/user	none	none
Student XXX	21478	gesprekken	conversation	WND INTERVIEW SUSANNE AGTERBOSCH	opened	false	system/user	none	none
Student XXX	21478	gesprekken	conversation	WND INTERVIEW SUSANNE AGTERBOSCH	finished	true	user	none	none
Student XXX	21478	locaties NIEUW	location	LOC-Terug naar Hal	accessible	true	system	none	none
Student XXX	21478	script Windenergie	condition	IF_OGB-WND-SAG-interview_AFGEROND	opened	true	system	none	none
Student XXX	21478	script Windenergie	action	THEN_LOC Terug naar Hal TOEGANKELIJK	opened	true	custom	none	none

The aggregated log file

Student XXX	21454	gesprekken	map	theoretisch kader en onderzoeksmethode	outfolded	true	user
Student XXX	21454	gesprekken	question	Vanuit welk theoretisch perspectief op belei	opened	true	user
Student XXX	21454	gesprekken	question	Vanuit welk theoretisch perspectief op belei	outfoldable	true	system
Student XXX	21454	gesprekken	question	Vanuit welk theoretisch perspectief op belei	selected	true	user
Student XXX	21454	gesprekken	fragment	OGB-WND-SAG-INT-006	opened	true	system
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Primary (easy) variables

- T Total time spend
- N_L Number of locations (re-)visited
- N_R Number of information resources accessed
- N_V Number of videos accessed
- N_P Number of pre-test answers given, including improvements
- S_P Pre-test score

and

- S_F **Final marks** assigned by the examiner on the basis of submitted reports.



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Descriptive statistics

	Average per student	Coefficient of variation
Total time T	53.8 h	0.44
Pre-test score S_p	6.6	0.18
Final score S_F	6.6	0.24
Resources accessed N_R	180	0.54
Videos accessed N_V	120	0.35
Locations accessed N_L	156	0.39
Pre-test answers N_p	65	0.65



Correlating access rates

Variables	Correlation r	p-value
Resources N_R/T , locations N_L/T	.500	<.001
Resources N_R/T , videos N_V/T	.484	<.001
Videos N_V/T , locations N_L/T	.576	<.001

→ $R^2 = 0.23 \dots 0.33$

→ “Switching behaviour”



Switching behaviour as a predictor of learning efficiency

- Learning efficiency S_F/T
To be explained by switching behaviours?

We found a significant linear model
 $S_F/T = 0.037 * N_V/T + 0.022 * N_L/T$

$R^2 = .545$ ($F(3, 114) = 45.6, p < 0.001$)

Switching behaviour is a predictor of learning efficiency. It explains 54% of variance of scores per unit time.

- Similar regression model for prediction of total time

$R^2 = 0.445$ ($F(2, 115) = 46.0, p < 0.001$)

Fast switchers study faster

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Conclusions

- If we offer freedom of movement, we see behavioural variability
- We observe moderate cross correlations between access rates, suggesting a pattern of: “Switching behaviour”.
- Switching behaviour is found to explain up to 54% of variability of scores, and 45% of variability of total time spent
- No result for pre-test scores.



Next steps in research

- Investigating other games
- Develop and validate metrics for:
 - "freedom of movement"
 - behavioural patterns
- Theoretical foundation which allows for generalisation



Thank you for your attention!

wim.westera@ou.nl

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