Appendix A

Evaluation indicators

Our method provides two types of evaluation. On the one hand, the evaluation of the EEGC itself on aspects of motivation, user experience and learning evolution. This evaluation allows, in fine, to compare EEGCs in terms of performance by means of three indicators linked to the previously mentioned aspects. This we will call the *comparative evaluation*. On the other hand, it evaluates the relevance of the EEGCs in general. This part of the evaluation allows to conclude that the EEGCs are more effective than traditional learning methods and will be named *intrinsic evaluation*. This evaluation uses 70 indicators divided into 4 categories:

- Category 1: General Learning Effectiveness

- Category 2: Contextualized Learning Effectiveness (Demographics)

- Category 3: Contextualized Learning Effectiveness (Game Mechanics)

- Category 4: Contextualized Learning Effectiveness (Game Theme)

A.1   Comparative evaluation

The first indicator refers to the learning evolution between pre-test and post-test. It is obtained according to Equation A.1 where $\overline{S_{p,q}}$ is the average of the scores thatparticipants belonging to a given group (experimental or control) P gave to each of the questions q belonging to the set of Questions Q, i.e. $s_{(p,q)}$.

$$\overline{S_{p,q}} = \frac{\sum_{p \,\in\, P} \sum_{q \,\in\, Q} s_{(p,q)}}{\#P \times \#Q} = \text{Score P} \tag{A.1}$$

The second indicator concerns motivation, which will be evaluated according to Equation A.2 where $\overline{S_{p,q_m}}$ is the average of the scores that participants belonging to a given group (experimental or control) P have given to each of the questions q_m belonging to the set of questions related to the evaluation of motivation Q_m, i.e. $s_{(p,q_m)}$.

$$\overline{S_{p,q_m}} = \frac{\sum_{p \,\in\, P} \sum_{q_m \,\in\, Q_m} s_{(p,q_m)}}{\#P \times \#Q_m} = \text{Score P1} \tag{A.2}$$

As for user experience, it will be evaluated according to the Equation A.3 where $\overline{S_{p,q_{ux}}}$ is the average of the scores that participants belonging to a given group (experimental or control) P have given to each of the q_{ux} questions belonging to the set of questions related to the evaluation of the user experience Q_{ux}, i.e. $s_{(p,q_{ux})}$.

$$\overline{S_{p,q_{ux}}} = \frac{\sum_{p \,\in\, P} \sum_{q_{ux} \,\in\, Q_{ux}} s_{(p,q_{ux})}}{\#P \times \#Q_{ux}} = \text{Score P2} \tag{A.3}$$

A.2   Intrinsic evaluation

We have 7 indicators that allow us to evaluate the learning effectiveness of EEGCs compared to traditional teaching methods in general.

$\overline{EvolutionAGT_{(pr,po)}}$ (Equation A.4) is the average learning evolution of all control group members combined. PT is the set of participants who are members of the control group, po_t is the result of the post-test of participant t and pr_t is the pre-test score of participant t.

$$\overline{EvolutionAGT_{(pr,po)}} = \frac{\sum_{t \,\in\, \text{PT}} \frac{po_t - pr_t}{pr_t}}{\#PT} = \text{Indicator INDQ1.1A} \tag{A.4}$$

$\overline{EvolutionAGE_{(pr,po)}}$ (Equation A.5) is the average learning evolution of all members of the experimental groups combined. PE is the set of participants e who took part in the EEGC assessment as a member of an experimental group, po_e is the result of participant e's post-test and pr_e is the result of the pre-test of participant e.

$$\overline{EvolutionAGE_{(pr,po)}} = \frac{\sum_{e \,\in\, \text{PE}} \frac{po_e - pr_e}{pr_e}}{\#PE} = \text{Indicator INDQ1.1B} \tag{A.5}$$

INDQ1.2B is the median of the series of individual relative learning changes of the members of the experimental group. INDQ1.2A is its counterpart for the control group.

$\sigma_{EvolutionAGT}$ (Equation A.6) is the standard deviation of the learning evolution of all control group members combined. PT is the set of t participants in a control group, Ev_t is the learning trajectory of participant t and $\overline{Evt}$ is the average learning trajectory of all members of the control groups combined ('Equation A.5) .

$$\sigma_{EvolutionAGT} = \sqrt{\frac{1}{\#PT} \sum_{t=1}^{\#PT} (Ev_t - \overline{Evt})} = \text{Indicator INDQ1.3A} \tag{A.6}$$

$sigma_{EvolutionAGE}$ (Equation A.7) is the standard deviation of the learning evolution of all members of the experimental groups combined. PE is the set of participants in an experimental group, Ev_e is the learning trend of participant e and $\overline{Eve}$ is the average learning trend of all members of the experimental groups combined. members of the experimental groups combined ('Equation A.5) .

$$\sigma_{EvolutionAGE} = \sqrt{\frac{1}{\#PE} \sum_{e=1}^{\#PE} (Ev_e - \overline{Eve})} = \text{Indicator INDQ1.3B} \tag{A.7}$$

η_{EG} (Equation A.8) is the correlation ratio between the sample of values related to the learning evolution E and that related to the groups G. E_p is the relative learning evolution of a participant p belonging to the set of participants P (independently of her group). g is one of the classes of the factor "group". $\overline{E_g}$ is thus the average relative learning evolution for a type of group (experimental or control). Finally, $\#P_g$ is the cardinal of the sample specific to the group g.

$$\eta_{EG} = \frac{\sum_{g \in G} \#P_g (\overline{E_g} - \overline{E})^2}{\sum_{p \in P} (E_p - \overline{E})^2} = \text{Indicator INDQ1.4} \tag{A.8}$$

There are 21 indicators that allow us to evaluate the extent to which the effectiveness observed in general is confirmed independently of the type of student to whom the instruction is given.

$\overline{EvolutionD_x}$ (Equation A.9) is the generalized formula for the average learning evolution of all members of the experimental groups combined and belonging to the x class of demographic factor D. PD_x is the set of participants e who are members of an experimental group belonging to class x of demographic factor D; po_e is the post-test score of participant e and pr_e is the result of the pre-test of participant e. We should understand D_x (Equation A.9) as a variable that allows to avoid rewriting relatively similar formulas. The set of values that can be taken by Dx consists of the different classes related to the demographic factors. Through the variabilization of the classes and demographic factors, Equation A.9 alone represents 9 formulas (Table A.1 - column "ADx").

$$\overline{EvolutionD_x \,_{(pr,po)}} = \frac{\sum_{e \,\in\, PD_x} \frac{po_e - pr_e}{pr_e}}{\#PD_x} = \text{Indicator INDQ2.ADx} \tag{A.9}$$

$\sigma_{EvolutionDx}$ (Equation A.10) is the standard deviation of the learning evolution of all members of the experimental groups combined and belonging to class x of demographic factor D. PDx is the set of participants e in an experimental group belonging to class x of demographic factor D; Ev_e is the learning evolution of participant e and $\overline{EveDx}$ is the average learning evolution of all members of the members of the combined experimental groups belonging to the class x linked to the demographic factor D. Following the example of $\overline{EvolutionD_{x(pr,po)}}$, we have variabilized the formula $\sigma_{EvolutionDx}$. The set of values that can be taken by Dx consists of the different classes related to the demographic factors. By variabilizing the classes and demographic factors, Equation A.10 alone represents 9 formulas (Table A.1 - column "BDx").

$$\sigma_{EvolutionD_{x\ (pr,po)}} = \sqrt{\frac{1}{\#PD_x} \sum_{e=1}^{\#PD_x} (Ev_e - \overline{EveDx})} = \text{Indicator INDQ2.BDx} \qquad (A.10)$$

Demographic factor	Ref.[1]	Class	ADx	BDx
Age	D01	16-25 years	INDQ2.1A	INDQ2.2A
Age	D01	26-35 years	INDQ2.1B	INDQ2.2B
Age	D01	26+ years	INDQ2.1C	INDQ2.2C
Prior knowledge	D02	None	INDQ2.1D	INDQ2.2D
Prior knowledge	D02	Novice	INDQ2.1E	INDQ2.2E
Prior knowledge	D02	Confirmed	INDQ2.1F	INDQ2.2F
Prior knowledge	D02	Expert	INDQ2.1G	INDQ2.2G
Gender	D04	Female	INDQ2.1H	INDQ2.2H
Gender	D04	Male	INDQ2.1I	INDQ2.2I

Table A.1: Class correspondence table for demographic factors.

$S(E, DA)$ (Equation A.11) is the linear correlation coefficient between the sample of values for the learning outcome E and the age of the participants. E_p is the learning outcome of a participant p belonging to the set of members of the experimental group PE; and DA_p is the age of a participant p.

$$S(E, DA) = \left| \frac{\sum_{p \in P}(E_p - \overline{E})(DA_p - \overline{D})}{\sqrt{\sum_{p \in P}(E_p - \overline{E})^2}\sqrt{\sum_{p \in E}(DA_p - \overline{D})^2}} \right| = \text{Indicator INDQ2.3DA} \qquad (A.11)$$

η_{DS} (Equation A.12) is the correlation ratio between the sample of values for the learning outcome E and the gender of the participants. E_p is the relative learning outcome of a participant p belonging to the whole set of members of the experimental group PE. s is one of the classes of the demographic factor "gender". $\overline{E_s}$ is therefore the average relative learning change for a particular gender (see "Class" in Table A.1). Finally, $\#P_s$ is the cardinal of the sample specific to gender s.

$$\eta_{DS} = \frac{\sum_{s \in S} \#P_s(\overline{E_s} - \overline{E})^2}{\sum_{p \in PE}(E_p - \overline{E})^2} = \text{Indicator INDQ2.3DB} \qquad (A.12)$$

η_{DC} (Equation A.13) is the correlation ratio between the sample of values related to the learning evolution E and the participants' prior knowledge. E_p is the relative learning evolution of a participant p belonging to the set c is one class of the demographic factor "prior knowledge". Thus, $\overline{E_c}$ is the average relative learning change for a type of prior knowledge (see "Class" in Table A.1). Finally, $\#P_c$ is the cardinal of the sample specific to prior knowledge c.

$$\eta_{DC} = \frac{\sum_{c \in C} \#P_c (\overline{E_c} - \overline{E})^2}{\sum_{p \in PE} (E_p - \overline{E})^2} = \text{Indicator INDQ2.3DC} \qquad (A.13)$$

The next three indicators allow to evaluate to what extent the efficiency observed in a general way is confirmed independently of the type of game mechanics applied in the EEGC.

η_{ES} (Equation A.14) is the correlation ratio between the sample of values related to the learning evolution E and the application game structure in the EEGC S_p . E_p is the relative learning evolution of a participant p belonging to the set of the members of the experimental group PE. s is one of the classes of the "game structure" factor. $\overline{E_s}$ is thus the average relative learning evolution for a type of game structure (open/path-based/sequential). Finally, $\#P_s$ is the cardinal of the sample specific to the structure type s.

$$\eta_{ES} = \frac{\sum_{s \in S} \#P_s (\overline{E_s} - \overline{E})^2}{\sum_{p \in PE} (E_p - \overline{E})^2} = \text{Indicator INDQ3.1} \qquad (A.14)$$

$S(E, D)$ (Equation A.15) is the linear correlation coefficient between the sample of values related to the learning evolution E and that related to the duration of play D. E_p is the learning evolution of a participant p belonging to the set of members of the experimental group PE and D_p is the duration of the EEGC in which a participant p took part.

$$S(E, D) = \left| \frac{\sum_{p \in PE} (E_p - \overline{E})(D_p - \overline{D})}{\sqrt{\sum_{p \in P} (E_p - \overline{E})^2} \sqrt{\sum_{p \in PE} (D_p - \overline{D})^2}} \right| = \text{Indicator INDQ3.2} \qquad (A.15)$$

$S(E, N)$ (Equation A.16) is the linear correlation coefficient between the sample of values related to the learning evolution E and the one related to the number of players per team N. E_p is the learning evolution of a participant p belonging to the set of the members of the experimental group PE and N_p is the number of players per team having accompanied a participant p during the experiment.

$$S(E, N) = \left| \frac{\sum_{p \in PE} (E_p - \overline{E})(N_p - \overline{N})}{\sqrt{\sum_{p \in P} (E_p - \overline{E})^2} \sqrt{\sum_{p \in PE} (N_p - \overline{N})^2}} \right| = \text{Indicator INDQ3.3} \qquad (A.16)$$

There are 39 indicators that allow to evaluate the extent to which the effectiveness observed in general is confirmed independently of the type of student to whom the instruction is given.

$\overline{EvolutionT_xE}_{(pr,po)}$ (Equation A.17) is the generalized formula for the average learning evolution of all members of the experimental groups who participated in a EEGC on theme T_x. PT_x is the set of participants e who took part in a EEGC on the theme T_x; po_e is the result of the post-test of participant e while pr_e is the result of the pre-test of participant e.

T_x (Equation A.17) is a class of the set "themes". By this variabilization, Equation A.17 alone represents 18 formulas (Table A.2 - column "TM(G)").

$$\overline{EvolutionT_xE}_{(pr,po)} = \frac{\sum_{e \, \in \, PT_x} \frac{po_e - pr_e}{pr_e}}{\#PT_x} = \text{Indicator INDQ4.xAE} \qquad (A.17)$$

A formula similar to Equation A.17 that we will name "INDQ4.xAT" (or $\overline{EvolutionTxT}_{(pr,po)}$) will also be proposed in our method to address the same problem, but this time for the control group.

$\sigma_{EvolutionT_xE}$ (Equation A.18) is the generalized formula of the standard deviation of the learning evolution of all the members of the experimental groups who participated in an EEGC on a theme T_x. PT_x is the set of participants e who took part in the evaluation of an EEGC on a theme T_x; Ev_e is the learning evolution of participant e and $\overline{EveTx}$ is the average learning evolution of all members of the combined experimental groups who participated in the evaluation of an EEGC via the Evscape method for a theme T_x.

x (Equation A.18) is a class of the set "themes". By this variabilization, Equation A.18 alone represents 18 indicators (Table A.2 - column "TE(G)").

$$\sigma_{EvolutionT_x E_{(pr,po)}} = \sqrt{\frac{1}{\#PT_x} \sum_{e=1}^{\#PT_x} (Ev_e - \overline{EveT_x})} = \text{Indicator INDQ4.xBE} \qquad (A.18)$$

A formula similar to Equation A.18 that we will denote by "INDQ4.xBT" (or $\sigma_{EvolutionT_x T_{(pr,po)}}$) is also proposed in our method in order to address the same problem but this time for the control group.

η_{ET} (Equation A.19) is the correlation ratio between the sample of values related to the learning evolution E and that related to the learning theme T for the for the experimental group. E_p is the learning evolution of a participant p; t is one of the classes of the factor "Theme". $\overline{E_t}$ is thus the average relative learning evolution for a particular theme (see "Theme" in Table A.2). Finally, $\#P_t$ is the cardinal of the sample specific to the theme type t.

$$\eta_{DS} = \frac{\sum_{t \in T} \#P_t (\overline{E_t} - \overline{E})^2}{\sum_{p \in PE} (E_p - \overline{E})^2} = \text{Indicator INDQ4.19} \qquad (A.19)$$

A formula similar to Equation A.19 that we will name "INDQ4.20" (or $S_t(E,T)$) will also be proposed in our method in order to address the same problem but this time for the control group.

Theme	TME	TEE	TMT	TET
Algorithms & complexity	INDQ4.1AE	INDQ4.1BE	INDQ4.1AT	INDQ4.1BT
Architecture & organization	INDQ4.2AE	INDQ4.2BE	INDQ4.2AT	INDQ4.2BT
Computational science	INDQ4.3AE	INDQ4.3BE	INDQ4.3AT	INDQ4.3BT
Discrete structures	INDQ4.4AE	INDQ4.4BE	INDQ4.4AT	INDQ4.4BT
Graphism and visual IT	INDQ4.5AE	INDQ4.5BE	INDQ4.5AT	INDQ4.5BT
Human-machine interaction	INDQ4.6AE	INDQ4.6BE	INDQ4.6AT	INDQ4.6BT
Security	INDQ4.7E	INDQ4.7BE	INDQ4.7T	INDQ4.7BT
Information management	INDQ4.8AE	INDQ4.8BE	INDQ4.8AT	INDQ4.8BT
Intelligent systems	INDQ4.9AE	INDQ4.9BE	INDQ4.9AT	INDQ4.9BT
Networks & communications	INDQ4.10AE	INDQ4.10BE	INDQ4.10AT	INDQ4.10BT
Operating systems	INDQ4.11AE	INDQ4.11BE	INDQ4.11AT	INDQ4.11BT
Platform-based development	INDQ4.12AE	INDQ4.12BE	INDQ4.12AT	INDQ4.12BT
Parallelism & distributed computing	INDQ4.13AE	INDQ4.13BE	INDQ4.13AT	INDQ4.13BT
Programming Languages	INDQ4.14AE	INDQ4.14BE	INDQ4.14AT	INDQ4.14BT
Software development fundamentals	INDQ4.15AE	INDQ4.15BE	INDQ4.15AT	INDQ4.15BT
Software Engineering	INDQ4.16AE	INDQ4.16BE	INDQ4.16AT	INDQ4.16BT
Fundamental computer science	INDQ4.17AE	INDQ4.17BE	INDQ4.17AT	INDQ4.17BT
Social & professional aspects	INDQ4.18AE	INDQ4.18BE	INDQ4.18AT	INDQ4.18BT

Table A.2: Correspondence table of the classes related to the themes. TME = denomination of the mean indicator for a theme (experimental group) / TEE = denomination of the standard deviation indicator for a theme (experimental group) / TMT = denomination of the mean indicator for a theme (control group) / TET = denomination of the standard deviation indicator for a theme (control group)

Appendix B

SUS questionnaire

	Strongly Disagree				Strongly Agree

1. I think that I would like to use this product frequently.

1	2	3	4	5

2. I found the product unnecessarily complex.

1	2	3	4	5

3. I thought the product was easy to use.

1	2	3	4	5

4. I think that I would need the support of a technical person to be able to use this product.

1	2	3	4	5

5. I found the various functions in the product were well integrated.

1	2	3	4	5

6. I thought there was too much inconsistency in this product.

1	2	3	4	5

7. I imagine that most people would learn to use this product very quickly.

1	2	3	4	5

8. I found the product very awkward to use.

1	2	3	4	5

9. I felt very confident using the product.

1	2	3	4	5

10. I needed to learn a lot of things before I could get going with this product.

1	2	3	4	5

Figure B.1: Questionnaire SUS - (source : [?, ?])

Appendix C

MEEGA questionnaire

Demographic Information	
Institution	
Course/degree	
Subject	
Age group	( ) Under 18 years ( ) 18 to 28 years ( ) 29 to 39 years ( ) 40 to 50 years ( ) Over 50 years
Gender	( ) Male ( ) Female
How often do you play digital games?	( ) Never ( ) Rarely: from time to time ( ) Monthly: at least once a month ( ) Weekly: at least once a week ( ) Daily: every day.
How often do you play non-digital games (card or board games, etc.)?	( ) Never ( ) Rarely: from time to time ( ) Monthly: at least once a month ( ) Weekly: at least once a week ( ) Daily: every day

No.	Dimension	Sub-dimension	Item Description
Quality factor: Player Experience			
1		Focused Attention	There was something interesting at the beginning of the game that captured my attention
2		Focused Attention	I was so involved in my gaming task that I lost track of time
3			I forgot about my immediate surroundings while playing this game
4		Fun	I had fun with the game
5		Fun	Something happened during the game (game elements, competition, etc.) which made me smile
6		Challenge	This game is appropriately challenging for me
7		Challenge	The game provides new challenges (offers new obstacles, situations or variations) at an appropriate pace
8			The game does not become monotonous as it progresses (repetitive or boring tasks)
9		Social Interaction	I was able to interact with other players during the game
10			The game promotes cooperation and/or competi-

Figure C.1: Questionnaire MEEGA (partie 1) - (source : [?, ?])

			tion among the players
11			I felt good interacting with other players during the game
12	Confidence		When I first looked at the game, I had the impression that it would be easy for me
13			The contents and structure helped me to become confident that I would learn with this game
14	Relevance		The game contents are relevant to my interests
15			It is clear to me how the contents of the game are related to the course
16			This game is an adequate teaching method for this course
17			I prefer learning with this game to learning through other ways (e.g. other teaching methods)
18	Satisfaction		Completing the game tasks gave me a satisfying feeling of accomplishment
19			It is due to my personal effort that I managed to advance in the game
20			I feel satisfied with the things that I learned from the game
21			I would recommend this game to my colleagues
22	Usability	Aesthetics	The game design is attractive (interface, graphics, board, cards, etc.)
23			The text font and colors are well blended and consistent
24		Learnability	I needed to learn a few things before I could play the game
25			Learning to play this game was easy for me
26			I think that most people would learn to play this game very quickly
27		Operability	I think that the game is easy to play
28			The game rules are clear and easy to understand
29		Accessibility	The fonts (size and style) used in the game are easy to read
30			The colors used in the game are meaningful
31			(Digital games) The game allows customizing the appearance (font and/or color) according to my preferences
32		Error prevention and recovery (Digital games)	(Digital games) – The game prevents me from making mistakes
33			(Digital games) - When I make a mistake it is easy to recover from it quickly
Quality factor: Perceived Learning			
34	Shor-term learning		The game contributed to my learning in this course

Figure C.2: Questionnaire MEEGA (partie 2) - (source : [?, ?])

35		The game allowed for efficient learning compared with other activities in the course
36 ...	Learning goals	This statement is repeated for each goal of the game. The game contributed to <verb as level of the learning goal (cognitive, psychomotor, affective)> <goal/concept>. An example in accordance with the learning goals of SCRUMIA (Gresse von Wangenheim et al., 2013): The game contributed to recall the concepts from Sprint Planning.

Please list three strong aspects of the game:

_____
_____
_____

Please give three suggestions to improve the game:

_____
_____
_____

Any further comment?

_____
_____
_____

Figure C.3: Questionnaire MEEGA (partie 3) - (source : [?, ?])

Appendix D

IGE questionnaire

Dimension	Gagne's Events of Instruction	ARCS Model	Playability/ Usability Heuristics	Question
Captivate Interest	Gain attention Capture the attention of the learner	1.Attention Capturing the interest of learners; stimulating the curiosity to learn How can I make this learning experience stimulating and interesting?	Playability Heuristic- Concentration	1. Do you have total concentration while playing the game?
			Playability Heuristics- Immersion	2. Does the storyline relate to your life experiences and grabs your interest? 3. Does the game stimulate your curiosity and make you want to explore? 4. Are the visuals, animation and music able to capture your interest? 5. Are there variations that are able to maintain your attention?
			Usability Heuristic -Aesthetic and minamalist design	6. Do you find the on-screen interface clutter-free and intuitive to navigate? 7. Do the font types and sizes used allow for easy reading?
Meet Learning Needs	2. Inform learners of objectives	2.Relevance Meeting the personal needs/ goals of the learner to effect a positive attitude In what ways will this learning experience be valuable for my students?	Playability Heuristic- Clear Goals	8. Are the learning objectives of the game clear to you?
	3. Stimulate recall of prior learning Relevant to the context of the target group characteristics and prerequisites		Playability Heuristic- Clear Goals	9. Does the game help you to associate new knowledge and skills with your prior knowledge and skills?
			Usability Heuristic- Recognition rather than recall	10. Are instructions visible and or easily retrievable so that you do not have to memorize them?
			Usability Heuristic - Match between system and the real world	11. Are the words and phrases of the games easy to understand? 12. Does role-playing as the avatar help you associate the life problems presented in the game with your problems?
	4. Present the content Well-defined instructions and exposures to new knowledge and skills		Playability Heuristic- Clear Goals	13. Do you learn new concepts and skills? 14. Do you understand the instructions given?
Build Player's Confidence	5. Provide "learning guidance" -Ability to learn is developed by increasing levels of difficulty and availability of different choices.	3.Confidence/ Challenge Helping the learners believe/ feel that they will succeed and control their success How can I via instruction help the students succeed and allow them to control their success?	Playability Heuristic- Challenge	15. Does the game provide a challenge at an appropriate difficulty level? 16. Do you feel confident playing the game even if you have only the online help as a reference? 17. When playing the game, did you experience the level of challenge that matches your skill level?
			Usability Heuristic – Help and documentation	18. Can you easily get help during your game play and find this "help" useful for you to achieve the goals and learning objectives?
			Usability Heuristic – Error prevention	19. Do you encounter errors? 20. Are there warning messages and cues and do you find them useful and help you make less mistakes?

Figure D.1: Questionnaire IGE (partie 1) - (source : [?, ?])

			Usability Heuristic -Help users recognize, diagnose, and recover from errors	21. Does the game help you to diagnose your own error?
	6. Elicit performance Opportunity to practice		Playability Heuristic- Challenge	22. Do you achieve the learning objectives?
			Playability Heuristic- Control	23. Do you feel a sense of control of the playing actions you take and the strategies that you use?
			Usability Heuristic- Flexibility and efficiency of use	24. Do you find the game controls and on-screen interface features simple and easy to navigate in the game environment?
			Usability Heuristic -User control and feedback	25. Does the game allow you to initiate and control actions?
			Usability Heuristic -Consistency and standards	26. Do you find consistency in the game i.e. commands and words are consistent? 27. Do you find the user interface (e.g. controls, color, graphics and dialogue design) consistent? 28. Once you learn a function, do you find it applicable throughout the entire game without the need to relearn?
Assess Achievement	7. Provide feedback Opportunity to self-assess learning	4.Satisfaction /Success Reinforcing accomplishment with rewards What can I do to help the students feel good about their experience and desire to continue learning	Playability Heuristics- Feedback	29. When playing the game, do you receive immediate feedback on your actions? 30. Can you gauge your overall progress at each stage of your game? 31. Do the game rules assign a final score to the end of each session? 32. Does the game have a structure that gives you a sense of where you are in the overall experience
			Usability Heuristic- Visibility of system status	33. Does the game keep you informed about what goes on? 34. Does it provide you with feedback for your action?
	8. Assess performance Provision of Incentives and Rewards		Playability Heuristics-Clear Goals	35. Does the game reward you appropriately for your effort and skill development? 36. Do you experience satisfaction and success after playing the game? 37. Are there clear intermediate goals presented at appropriate times? 38. Are the overall goals of the game clearly defined and presented early?
	9. Enhance retention and transfer of skills Reflection to help reinforcement of skills .		Playability Heuristics-Clear Goals	39. Does the game allow you to do reflection on your learning? 40. Does the feedback and online help reinforce your understanding? 41. Will you to be able to apply the newly acquired knowledge? 42. Do you want to play more of the game?

Figure D.2: Questionnaire IGE (partie 2) - (source : [?, ?])

Appendix E

HEEG questionnaire

Category	Heuristic	Criteria	Source
Game Play	Enduring Play	The players find the game fun, with no repetitive or boring tasks.	PLAY
		Player should not experience being penalized repetitively for the same failure.	HEP
	Challenge, Strategy and Pace	Player's fatigue is minimized by varying activities and pacing during game play.	HEP
	Goals	The game goals are clear. The game provides clear goals, presents overriding goals early as well as short term goals throughout game play.	PLAY
Enjoyment	Immersion	Game should react in a consistent, challenging, and exciting way to the player's actions (e.g., appropriate music with music with the action).	HEP
		The game utilizes visceral, audio and visual content to further the players' immersion in the game.	PLAY
	Concentration	Games should provide a lot of stimuli from different sources.	GameFlow
		Games must provide stimuli that are worth attending to.	GameFlow
		Games should quickly grab the players' attention and maintain their focus throughout the game.	GameFlow
		Players shouldn't be burdened with tasks that don't feel important.	GameFlow
		Players should not be distracted from tasks that they want or need to concentrate on.	GameFlow
Usability & Game Mechanics	Documentation/ Tutorial	Player does not need to read the manual, tutorial, or documentation to play.	HEP
		Player is given controls that are basic enough to learn quickly, yet expandable as player attain for new goals and challenges.	HEP/ Play
		Learning the game should not be boring, but be part of the fun.	GameFlow
	Game Provides Feedback	A player should always be able to identify their score/status and goal in the game.	HEP
		Game provides feedback and reacts in a consistent, immediate, challenging and exciting way to the players' actions. Providing appropriate audio/visual/visceral feedback (music, sound effects).	PLAY
	Screen Layout	Screen layout is visually pleasing (in controller, color, typographic, dialogue and user interface design).	HEP
		Player experiences the user interface as consistent, efficient and integrated (menu as a part of the game).	PLAY
	Navigation	Player experiences the user interface/HUD navigation as logical and minimalist.	PLAY
	Error Prevention	Player error is avoided.	PLAY
		Upon turning on the game, the player has enough information to begin.	PLAY
		Players should be given context sensitive help while playing so that they are not stuck and need to rely on a manual for help.	PLAY
		All levels of players are able to play and get involved quickly and easily with tutorials, and/or progressive or adjustable difficulty levels.	PLAY
	Control	Players should feel a sense of control over the game interface and input devices.	GameFlow
		Game controls are consistent within the game and follow standard conventions.	PLAY
Educational Design	Supports active learning	Encourages exploration, problem solving, and enquiry.	N J Whitton
		Game goals align with learning goals.	N J Whitton
	Engenders engagement	Stimulates curiosity.	N J Whitton
		Appropriate challenge.	N J Whitton
		Provides control over the learning environment.	N J Whitton
	Appropriateness	Fits with curriculum and assessment.	N J Whitton
		Personally relevant for students.	N J Whitton
	Supports reflection	Opportunities for reflection and debriefing on learning.	N J Whitton
		Highlights process of learning.	N J Whitton
	Provides equitable experience	Accounts for differing prior knowledge.	N J Whitton
		Provides equal opportunities to participate.	N J Whitton

Figure E.1: Questionnaire HEEG - (source : [?, ?])

Appendix F

GUESS questionnaire

TABLE 2: Demographics of Participants in the EFA ($N = 629$) and CFA ($N = 771$) Studies

Variable	EFA Value	CFA Value
Age in years ($M \pm SD$)	24.61 ± 7.18	25.87 ± 7.97
Age range in years	18–61	18–60
Gender (%)		
Male	58.0	62.6
Female	42.0	37.4
Ethnicity (%)		
American Indian/Alaskan Native	1.4	2.7
Asian/Pacific Islander	13.5	11.5
Black/African American	5.6	3.2
Hispanic/Latino	8.7	5.8
White (not of Hispanic origin)	63.4	70.6
Biracial/multiracial/mixed	4.9	2.9
I do not wish to answer	2.4	3.2
Education level (%)		
Some high school	3.2	2.1
High school graduate or GED	14.0	10.0
Some college	49.1	46.2
College graduate (2- and 4-year degree)	27.0	33.9
Postgraduate degree (MA, PhD, law, or medical)	6.7	7.9
Type of video game player (%)		
Newbie/novice	6.5	5.8
Casual	39.9	36.3
Midcore/core	38.3	38.9
Hardcore/expert	15.3	18.9
Mean hours spent playing game per week (%)		
Less than 1 hr	6.7	6.0
1–4 hr	22.3	22.6
5–9 hr	24.0	23.7
10–19 hr	23.4	23.9
20–29 hr	14.8	14.8
30–39 hr	2.9	3.6
More than 40 hr	6.0	5.4

Note. EFA = exploratory factor analysis; CFA = confirmatory factor analysis.

Figure F.1: Questionnaire GUESS (partie 1) - (source : [?, ?])

TABLE 3: Overview of the Games Evaluated in the EFA (*N* = 629) and CFA (*N* = 771) Studies

Variable	EFA (%)	CFA (%)
Last time played		
Today	25.4	25.7
Yesterday	25.9	31.6
Last week	30.0	27.4
Last month	14.3	11.7
About 2–3 months ago	4.3	3.6
Total time spent playing		
10–19 hr	14.8	13.2
20–39 hr	21.0	20.0
40–79 hr	20.8	19.1
80–120 hr	12.1	10.9
More than 120 hr	31.3	36.8
Gaming device used		
Computer device (e.g., laptop, desktop)	36.6	42.5
Console device (e.g., Xbox 360, Nintendo Wii)	48.5	41.1
Handheld gaming device (e.g., Game Boy Advance)	5.1	4.0
Mobile device (e.g., smartphone, tablet)	9.4	12.3
Other (e.g., arcade)	0.5	0.0
Overall satisfaction level		
Extremely dissatisfied	0.5	0.3
Dissatisfied	0.3	0.4
Somewhat dissatisfied	0.8	0.3
Neither satisfied nor dissatisfied	1.3	1.0
Somewhat satisfied	6.2	4.7
Satisfied	43.6	44.9
Extremely satisfied	47.4	48.5

Note. EFA = exploratory factor analysis; CFA = confirmatory factor analysis.

Figure F.2: Questionnaire GUESS (partie 2) - (source : [?, ?])

Item	M	SD	Factor Loadings Pattern	Factor Loadings Structure	h^2
I think it is easy to learn how to play the game.	5.68	1.50	.77	.64	.51
I find the controls of the game to be straightforward.	6.13	1.12	.69	.67	.48
I always know how to achieve my goals/objectives in the game.	5.67	1.28	.66	.61	.40
I find the game's interface to be easy to navigate.	5.93	1.09	.64	.67	.48
I do not need to go through a lengthy tutorial or read a manual to play the game.	5.76	1.49	.56	.48	.28
I find the game's menus to be user friendly.	5.83	1.15	.53	.58	.36
I feel the game trains me well in all of the controls.	5.60	1.32	.52	.55	.34
I always know my next goal when I finish an event in the game.	5.46	1.40	.47	.48	.30
I feel the game provides me the necessary information to accomplish a goal within the game.	5.68	1.18	.47	.59	.40
I think the information provided in the game (e.g., onscreen messages, help) is clear.	5.88	1.05	.43	.56	.38
I feel very confident while playing the game.	5.56	1.18	.41	.54	.42

Figure F.3: Questionnaire GUESS (partie 3)- (source : [?, ?])

Item	M	SD	Factor Loadings Pattern	Factor Loadings Structure	h^2
I think the characters in the game are well developed.	5.17	1.61	.84	.76	.60
I am captivated by the game's story from the beginning.	5.14	1.62	.84	.85	.73
I enjoy the fantasy or story provided by the game.	5.79	1.28	.61	.75	.63
I can identify with the characters in the game.	4.55	1.72	.60	.56	.37
I am emotionally moved by the events in the game.	4.15	1.82	.58	.65	.50
I am very interested in seeing how the events in the game will progress.	5.88	1.25	.51	.70	.57
I can clearly understand the game's story.	5.91	1.22	.48	.48	.31

Figure F.4: Questionnaire GUESS (partie 4) - (source : [?, ?])

Item	M	SD	Factor Loadings		h^2
			Pattern	Structure	
I feel detached from the outside world while playing the game.	4.27	1.80	.76	.67	.48
I do not care to check events that are happening in the real world during the game.	4.07	1.82	.75	.61	.44
I cannot tell that I am getting tired while playing the game.	4.22	1.91	.67	.62	.40
Sometimes I lose track of time while playing the game.	5.67	1.46	.61	.68	.51
I temporarily forget about my everyday worries while playing the game.	5.32	1.47	.56	.64	.43
I tend to spend more time playing the game than I have planned.	5.28	1.60	.52	.58	.38
I can block out most other distractions when playing the game.	5.49	1.34	.49	.59	.40
Whenever I stopped playing the game I cannot wait to start playing it again.	4.78	1.50	.49	.64	.46

Figure F.5: Questionnaire GUESS (partie 5) - (source : [?, ?])

Item	M	SD	Factor Loadings		h^2
			Pattern	Structure	
I think the game is fun.	6.50	0.81	.88	.86	.75
I enjoy playing the game.	6.51	0.76	.86	.85	.73
I feel bored while playing the game.	2.45	1.46	-.58	-.55	.32
I am likely to recommend this game to others.	6.27	1.06	.58	.70	.52
If given the chance, I want to play this game again.	6.31	1.02	.55	.68	.54

Figure F.6: Questionnaire GUESS (partie 6) - (source : [?, ?])

Item	M	SD	Factor Loadings Pattern	Factor Loadings Structure	h^2
I feel the game allows me to be imaginative.	5.38	1.54	.90	.76	.61
I feel creative while playing the game.	4.91	1.60	.86	.76	.60
I feel the game gives me enough freedom to act how I want.	5.51	1.46	.62	.61	.42
I feel the game allows me to express myself.	4.62	1.64	.61	.68	.52
I feel I can explore things in the game.	5.66	1.47	.44	.61	.44
I feel my curiosity is stimulated as the result of playing the game.	5.42	1.41	.43	.67	.54
I think the game is unique or original.	5.60	1.51	.43	.57	.42

Figure F.7: Questionnaire GUESS (partie 7) - (source : [?, ?])

Item	M	SD	Factor Loadings Pattern	Factor Loadings Structure	h^2
I enjoy the sound effects in the game.	5.88	1.29	.87	.89	.80
I enjoy the music in the game.	5.68	1.53	.76	.80	.66
I feel the game's audio (e.g., sound effects, music) enhances my gaming experience.	5.92	1.43	.76	.78	.63
I think the game's audio fits the mood or style of the game.	6.17	1.04	.63	.73	.58

Figure F.8: Questionnaire GUESS (partie 8) - (source : [?, ?])

Item	M	SD	Factor Loadings Pattern	Factor Loadings Structure	h^2
I am in suspense about whether I will succeed in the game.	5.06	1.73	.70	.60	.42
I feel successful when I overcome the obstacles in the game.	6.19	0.92	.66	.68	.48
I want to do as well as possible during the game.	6.20	1.02	.62	.63	.45
I am very focused on my own performance while playing the game.	5.83	1.18	.57	.61	.43
I feel the game constantly motivates me to proceed further to the next stage or level.	5.81	1.24	.57	.67	.51
I find my skills gradually improve through the course of overcoming the challenges in the game.	6.23	1.00	.48	.55	.36

Figure F.9: Questionnaire GUESS (partie 9) - (source : [?, ?])

Item	M	SD	Factor Loadings Pattern	Factor Loadings Structure	h^2
I find the game supports social interaction (e.g., chat) between players.	4.78	1.93	.84	.83	.72
I like to play this game with other players.	5.28	1.97	.75	.76	.63
I am able to play the game with other players if I choose.	5.61	1.89	.71	.72	.54
I enjoy the social interaction within the game.	4.86	1.58	.64	.65	.54

Figure F.10: Questionnaire GUESS (partie 10) - (source : [?, ?])

Item	M	SD	Factor Loadings Pattern	Factor Loadings Structure	h^2
I enjoy the game's graphics.	6.19	1.00	.64	.70	.53
I think the graphics of the game fit the mood or style of the game.	6.27	0.89	.63	.68	.51
I think the game is visually appealing.	6.25	1.03	.59	.61	.40

Figure F.11: Questionnaire GUESS (partie 11) - (source : [?, ?])

Appendix G

Flow Scale For Games questionnaire

		Agree				Disagree
1	I was challenged, but I believed my skills would allow me to meet the challenge.	5	4	3	2	1
2	I could use the user interface of the game spontaneously and automatically without having to think.	5	4	3	2	1
3	I knew clearly what I wanted to do and achieve.	5	4	3	2	1
4	I was aware how I was performing in the game.	5	4	3	2	1
5	My attention was focused entirely on playing the game.	5	4	3	2	1
6	I felt in total control of my playing actions.	5	4	3	2	1
7	I was not concerned with what others may have been thinking about my playing performance.	5	4	3	2	1
8	My sense of time altered (either speeded up or slowed down).	5	4	3	2	1
9	I really enjoyed the playing experience.	5	4	3	2	1
10	The challenge that the game provided and my skills were at an equally high level.	5	4	3	2	1
11	The use of the user interface was easy to acquire.	5	4	3	2	1
12	The goals of the game were clearly defined.	5	4	3	2	1
13	I could tell by the way I was performing how well I was doing.	5	4	3	2	1
14	It was no effort to keep my mind on game events.	5	4	3	2	1
15	I had a feeling of control of my actions.	5	4	3	2	1
16	I was not worried about my performance during playing.	5	4	3	2	1
17	The way time passed seemed to be different from normal.	5	4	3	2	1
18	I loved the feeling of playing and want to capture it again.	5	4	3	2	1
19	I had total concentration while playing the game.	5	4	3	2	1
20	The playing experience left me feeling great.	5	4	3	2	1
21	I was totally immersed in playing the game.	5	4	3	2	1
22	I found the experience extremely rewarding.	5	4	3	2	1
23	Read the description of flow experience and answer to the following statement: I experienced a clear flow experience during playing.	5	4	3	2	1
	Description of flow: The word flow is used to describe a state of mind sometimes experienced by people who are deeply involved in some activity. For example, a football player may experience flow when nothing else matters but the game itself and it is going very well. Activity that induces flow totally captivates a person for some period of time, in which case time seems to distort and nothing else but the activity seems to matter. Flow may not last for a long time on any particular occasion, but it may come and go over time. Flow has been described as being an intrinsically enjoyable experience.					
24	If you experienced flow, what factors in the game contributed to flow experience?					
25	If you did not experience flow, what factors in the game disturbed achieving a flow experience?					

Figure G.1: Questionnaire FSFG - (source : [?, ?])

Appendix H

E-GameFlow questionnaire

Factor	Item no.	Content
Concentration	C1	*The game grabs my attention[a]*
	C2	*The game provides content that stimulates my attention[a]*
	C3	Most of the gaming activities are related to the learning task
	C4	No distraction from the task is highlighted
	C5	Generally speaking, I can remain concentrated in the game
	C6	I am not distracted from tasks that the player should concentrate on
	C7	I am not burdened with tasks that seem unrelated
	C8	Workload in the game is adequate
Goal Clarity	G1	Overall game goals were presented in the beginning of the game
	G2	Overall game goals were presented clearly
	G3	Intermediate goals were presented in the beginning of each scene
	G4	Intermediate goals were presented clearly
	G5	*I understand the learning goals through the game[a]*
Feedback	F1	I receive feedback on my progress in the game
	F2	I receive immediate feedback on my actions
	F3	I am notified of new tasks immediately
	F4	I am notified of new events immediately
	F5	I receive information on my success (or failure) of intermediate goals immediately
	F6	*I receive information on my status, such as score or level[a]*
Challenge	H1	*I enjoy the game without feeling bored or anxious[a]*
	H2	*The challenge is adequate, neither too difficult nor too easy[a]*
	H3	The game provides "hints" in text that help me overcome the challenges
	H4	The game provides "online support" that helps me overcome the challenges
	H5	The game provides video or audio auxiliaries that help me overcome the challenges
	H6	*My skill gradually improves through the course of overcoming the challenges[a]*
	H7	*I am encouraged by the improvement of my skills[a]*
	H8	The difficulty of challenges increase as my skills improved.
	H9	The game provides new challenges with an appropriate pacing
	H10	The game provides different levels of challenges that tailor to different players
Autonomy	A1	*I feel a sense of control the menu (such as start, stop, save, etc.)[a]*
	A2	*I feel a sense of control over actions of roles or objects[a]*
	A3	*I feel a sense of control over interactions between roles or objects[a]*
	A4	*The game does not allow players to make errors to a degree that they cannot progress in the game[a]*
	A5	*The game supports my recovery from errors[a]*
	A6	*I feel that I can use strategies freely[a]*
	A7	I feel a sense of control and impact over the game
	A8	I know next step in the game
	A9	I feel a sense of control over the game
Immersion	I1	I forget about time passing while playing the game
	I2	I become unaware of my surroundings while playing the game
	I3	I temporarily forget worries about everyday life while playing the game
	I4	I experience an altered sense of time
	I5	I can become involved in the game
	I6	I feel emotionally involved in the game
	I7	I feel viscerally involved in the game
Social Interaction	S1	I feel cooperative toward other classmates
	S2	I strongly collaborate with other classmates
	S3	The cooperation in the game is helpful to the learning
	S4	The game supports social interaction between players (chat, etc)
	S5	The game supports communities within the game
	S6	The game supports communities outside the game
Knowledge Improvement	K1	The game increases my knowledge
	K2	I catch the basic ideas of the knowledge taught
	K3	I try to apply the knowledge in the game
	K4	The game motivates the player to integrate the knowledge taught
	K5	I want to know more about the knowledge taught

Figure H.1: Questionnaire E-GameFlow - [?, ?]

Appendix I

Other questionnaires

TABLE 3. Results of the student survey (N = 28).

Question	M	MED	SD
What is your general opinion on the escape room? (1 Poor - 5 Very Good)	4.6	5.0	0.6
Please, state your level of agreement with the following statements (1 Strongly disagree - 5 Strongly agree):			
The escape room allowed me to improve my knowledge of the course materials	4.1	4.0	0.8
I learned more with the escape room than I would have with a computer lab session	4.0	4.0	0.8
I liked the escape room better than a computer lab session	4.7	5.0	0.7
The escape room was fun for me	4.4	4.5	0.6
The escape room was an immersive experience	4.3	4.0	0.7
The escape room was a stressful experience	2.0	2.0	1.1
The escape room was too hard	2.6	3.0	1.1
The difficulty of the escape room lies in mastering the course materials	3.8	4.0	0.9
I think I was prepared enough to succeed in the escape room	3.4	3.5	1.3
The escape room was well-organized	4.5	5.0	0.6
The duration of the escape room (2h) was adequate	4.1	4.0	1.1
The hint approach was adequate	3.7	4.0	1.3
I wish I received more help during the escape room	2.5	2.0	1.3
The initial guidance provided was enough	4.0	4.0	0.9
The supervision of the activity was adequate	4.5	5.0	0.6
I liked the fact that the escape room combined physical and digital puzzles	4.8	5.0	0.4
I liked the physical puzzles better than the digital ones	3.0	3.0	1.1
I liked participating in the escape room with a classmate	4.6	5.0	0.7
I would rather have participated on my own	1.4	1.0	1.0
I would rather have been part of a larger team	2.1	1.5	1.2
All the members of the team were equally involved in solving the different puzzles	4.0	4.0	1.1
	Yes	No	
Would you like other courses to include activities like this (even if it was not for a grade)?	100%	0%	
Would you recommend other students to participate in the escape room (even if it was not for a grade)?	100%	0%	

Figure I.1: Questionnaire divers 1 - (source : [?, ?])

Appendix A. Immersion questionnaire used in Experiments 1 and 2

Your personal experience of the game

Please rate how far you would agree with the statements below just before you were interrupted.

SD = strongly disagree; D = disagree; N = neutral; A = agree; SA = strongly agree.

I felt that I really empathised/felt for with the game.
SD   D   N   A   SA

I did not feel any emotional attachment to the game.
SD   D   N   A   SA

I was interested in seeing how the game's events would progress.
SD   D   N   A   SA

It did not interest me to know what would happen next in the game.
SD   D   N   A   SA

I was in suspense about whether I would win or lose the game.
SD   D   N   A   SA

I was not concerned about whether I would win or lose the game.
SD   D   N   A   SA

I sometimes found myself to become so involved with the game that I wanted to speak to the game directly.
SD   D   N   A   SA

I did not find myself to become so caught up with the game that I wanted to speak to directly to the game.
SD   D   N   A   SA

I enjoyed the graphics and imagery of the game.
SD   D   N   A   SA

I did not like the graphics and imagery of the game.
SD   D   N   A   SA

I enjoyed playing the game.
SD   D   N   A   SA

Playing the game was not fun.
SD   D   N   A   SA

The controls were not easy to pick up.
SD   D   N   A   SA

Figure I.2: Questionnaire divers 2 (partie 1) - (source : [?, ?])

There were not any particularly frustrating aspects of the controls to get the hang of.
SD   D   N   A   SA

I became unaware that I was even using any controls.
SD   D   N   A   SA

The controls were not invisible to me.
SD   D   N   A   SA

I felt myself to be directly travelling through the game according to my own volition.
SD   D   N   A   SA

I did not feel as if I was moving through the game according to my own will.
SD   D   N   A   SA

It was as if I could interact with the world of the game as if I was in the real world.
SD   D   N   A   SA

Interacting with the world of the game did not feel as real to me as it would be in the real world.
SD   D   N   A   SA

I was unaware of what was happening around me.
SD   D   N   A   SA

I was aware of surroundings.
SD   D   N   A   SA

I felt detached from the outside world.
SD   D   N   A   SA

I still felt attached to the real world.
SD   D   N   A   SA

At the time the game was my only concern.
SD   D   N   A   SA

Everyday thoughts and concerns were still very much on my mind.
SD   D   N   A   SA

I did not feel the urge at any point to stop playing and see what was going on around me.
SD   D   N   A   SA

I was interested to know what might be happening around me.
SD   D   N   A   SA

I did not feel like I was in the real world but the game world.
SD   D   N   A   SA

I still felt as if I was in the real world whilst playing.
SD   D   N   A   SA

To me it felt like only a very short amount of time had passed.
SD   D   N   A   SA

When playing the game time appeared to go by very slowly.
SD   D   N   A   SA

Figure I.3: Questionnaire divers 2 (partie 2) - (source : [?, ?])

How immersed did you feel? (10 = very immersed; 0 = not
at all immersed)

1   2   3   4   5   6   7   8   9   10

Appendix B. Immersion questionnaire used in Experiment 3

Your experience of the game

Please answer the following questions by circling the
relevant number. In particular, remember that these
questions are asking you about how you felt at the end
of the game.

To what extent did the game hold your attention?
Not at all   1   2   3   4   5   A lot

To what extent did you feel you were focused on the game?
Not at all   1   2   3   4   5   A lot

How much effort did you put into playing the game?
Very little   1   2   3   4   5   A lot

Did you feel that you were trying you best?
Not at all   1   2   3   4   5   Very much so

To what extent did you lose track of time?
Not at all   1   2   3   4   5   A lot

To what extent did you feel consciously aware of being in
the real world whilst playing?
Not at all   1   2   3   4   5   Very much so

To what extent did you forget about your everyday
concerns?
Not at all   1   2   3   4   5   A lot

To what extent were you aware of yourself in your
surroundings?
Not at all   1   2   3   4   5   Very aware

To what extent did you notice events taking place around you?
Not at all   1   2   3   4   5   A lot

Did you feel the urge at any point to stop playing and see
what was happening around you?
Not at all   1   2   3   4   5   Very much so

To what extent did you feel that you were interacting with
the game environment?
Not at all   1   2   3   4   5   Very much so

To what extent did you feel as though you were separated
from your real-world environment?
Not at all   1   2   3   4   5   Very much so

To what extent did you feel that the game was something
you were experiencing, rather than something you were just
doing?
Not at all   1   2   3   4   5   Very much so

To what extent was your sense of being in the game
environment stronger than your sense of being in the real
world?
Not at all   1   2   3   4   5   Very much so

Figure I.4: Questionnaire divers 2 (partie 3) - (source : [?, ?])

At any point did you find yourself become so involved that you were unaware you were even using controls?
Not at all   1   2   3   4   5   Very much so

To what extent did you feel as though you were moving through the game according to you own will?
Not at all   1   2   3   4   5   Very much so

To what extent did you find the game challenging?
Not at all   1   2   3   4   5   Very difficult

Were there any times during the game in which you just wanted to give up?
Not at all   1   2   3   4   5   A lot

To what extent did you feel motivated while playing?
Not at all   1   2   3   4   5   A lot

To what extent did you find the game easy?
Not at all   1   2   3   4   5   Very much so

To what extent did you feel like you were making progress towards the end of the game?
Not at all   1   2   3   4   5   A lot

How well do you think you performed in the game?
Very poor   1   2   3   4   5   Very well

To what extent did you feel emotionally attached to the game?
Not at all   1   2   3   4   5   Very much so

To what extent were you interested in seeing how the game's events would progress?
Not at all   1   2   3   4   5   A lot

How much did you want to "win" the game?
Not at all   1   2   3   4   5   Very much so

Were you in suspense about whether or not you would win or lose the game?
Not at all   1   2   3   4   5   Very much so

At any point did you find yourself become so involved that you wanted to speak to the game directly?
Not at all   1   2   3   4   5   Very much so

To what extent did you enjoy the graphics and the imagery?
Not at all   1   2   3   4   5   A lot

How much would you say you enjoyed playing the game?
Not at all   1   2   3   4   5   A lot

When interrupted, were you disappointed that the game was over?
Not at all   1   2   3   4   5   Very much so

Would you like to play the game again?
Definitely not   1   2   3   4   5   Definitely yes

Figure I.5: Questionnaire divers 2 (partie 4) - (source : [?, ?])

Question	M	MED	SD
What is your overall opinion on the escape room? (1 Poor – 5 Very Good)	4.6	5.0	0.6
What is your overall opinion on the Escapp platform? (1 Poor – 5 Very Good)	4.2	4.0	0.9
Please, state your level of agreement with the following statements (1 Strongly disagree – 5 Strongly agree):			
The escape room allowed me to improve my knowledge on software modeling	3.9	4.0	0.9
I learned more with the escape room than I would have with a practical computer lab session	3.3	3.0	1.2
I liked the escape room more than a practical computer lab session	4.2	5.0	1.0
The escape room was fun	4.6	5.0	0.7
The narrative of the escape room was attractive	4.7	5.0	0.6
The leaderboard was motivating	4.3	5.0	0.9
The escape room was an immersive experience	4.4	5.0	0.8
The escape room was a stressful experience	2.5	2.0	1.2
The escape room was too difficult	2.7	3.0	1.0
The main difficulty of solving the escape room puzzles lied in mastering the course materials	3.0	3.0	1.0
The main difficulty of solving the escape room puzzles lied in the game mechanics	3.5	4.0	0.9
I think I was prepared enough to succeed in the escape room	4.2	4.0	0.8
The escape room was well organized	4.3	5.0	0.9
The initial guidance provided was enough	4.1	4.0	0.9
The supervision of the activity was adequate	4.4	5.0	0.7
The duration of the escape room (2 hours) was adequate	4.3	5.0	1.0
I agree that the escape room must be a graded activity	4.2	5.0	1.1
The hint approach was adequate	4.1	4.0	1.0
The obtained hints were useful to progress in the escape room (N=124)*	3.9	4.0	1.2
I wish I received more help during the escape room	2.2	2.0	1.2
I liked participating in the escape room in a team (N=159)**	4.8	5.0	0.6
I would rather have participated on my own instead of in a team (N=159)**	1.6	1.0	1.0
I would rather have been part of a larger team (N=159)**	2.0	2.0	1.1
All the members of the team were equally involved in solving the different puzzles (N=159)**	4.2	4.0	0.8
The fact that the escape room was conducted remotely caused communication or collaboration problems with my team (N=159)**	1.9	2.0	1.1
I would have preferred that the escape room had been conducted face-to-face instead of remotely	3.4	3.0	1.2
I liked the fact that the escape room used digital puzzles	4.6	5.0	0.6
I would have liked the remote educational escape room to incorporate puzzles requiring interaction with physical objects (provided through printable documents or courier packages)	3.0	3.0	1.4

	Yes (%)	No (%)
Would you recommend other students to participate in the escape room (even if it was not for a grade)?	98.8	1.2
Would you like other courses to include activities like the escape room conducted (even if it was not for a grade)?	96.9	3.1

* These questions were answered only by those students who obtained at least one hint.

** These questions were answered only by those students who participated in the escape room in a team.

Figure I.6: Questionnaire divers 3 - (source : [?, ?])

Question	N	M	SD
What is your general opinion on the escape room? (1 Poor - 5 Very Good)	84	4.3	0.8
Please, state your level of agreement with the following statements (1 Strongly disagree - 5 Strongly agree):			
In general, I like to play games (video games, board games, etc.)	83	4.2	0.9
The front-end development part of the course has been easy for me	83	3.0	1.0
The escape room allowed me to improve my knowledge of the course materials	82	3.4	1.2
The escape room was fun for me	84	4.2	1.1
The escape room was too difficult	82	3.4	0.9
The escape room was well organised	83	3.9	1.0
I liked the escape room better than a computer lab session	82	4.5	0.9
I learned more with the escape room than I would have with a computer lab session	79	3.7	1.3
		Yes	No
Would you recommend other students to participate in the escape room (even if it was not for a grade)?	84	76 90.5%	8 9.5%
Would you like other courses to include activities like this (even if it was not for a grade)?	84	80 95.2%	4 4.8%

Figure I.7: Questionnaire divers 4 - (source : [?, ?])

students become aware of the actual objectives of the testing and focus their game usage in the aspects that are being assessed. Test questions must be very closely related to the expected learning/skills outcomes.

b) Motivation Questionnaire (students)

This questionnaire establishes, beforehand, the motivation of the student to the topic but also to the use of games.

For each of the following statements, please indicate how true it is for you, using the following scale:

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

not at all   somewhat   very

Competence

• I think I am good at _____

• I think I do pretty well at _____, compared to others

• I am satisfied with my performance at _____

• I am pretty skilled at _____

• I think I am pretty good at _____

Interest

• I think _____is quite enjoyable

• I think _____is very interesting

• I think _____is fun

• At _____I often think about how much I enjoy it

• I think _____is boring

Motivation for Computer Games

• Playing computer games is fun.

• I play computer games often.

• I can easily obtain knowledge through computer game play.

• I can usually relate to the main character while playing computer games.

not at all   somewhat   very

Interest/Enjoyment

• I enjoyed playing this game very much

• This game was fun to play.

• I thought this was a boring game.

• This game did not hold my attention at all.

• I would describe this game as very interesting.

• I thought this game was quite enjoyable.

• While I was playing this game, I was thinking about how much I enjoyed it.

Perceived Competence

• I think I am pretty good at this game.

• I think I did pretty well at this game, compared to other students.

• After working at this game for a while, I felt pretty competent.

• I am satisfied with my performance at this task.

• I was pretty skilled at this game.

User Experience

• I enjoyed learning through the game

• I could identify myself with the main character.

• After playing the game I can better imagine the era presented in the game.

• When I started playing the game I got enough information to start playing it.

• It took me some time to figure out how to play the game.

• There was enough feedback to know what I did wrong during the game and was able to do it correctly afterwards.

Figure I.8: Questionnaire divers 5 - (source : [?, ?])

Appendix J

EvscApp questionnnaire

Questionnaire démographique Evscape	
Quel âge avez-vous ?	
De quel genre êtes vous ?	Femme
	Homme
Quel est votre niveau d'études actuel ?	Secondaire inférieur
	Secondaie supérieur
	Baccalauréat
	Master
Dans quelle région du monde avez vous vécu le plus longtemps au cours de ces 5 dernières années ?	Afrique
	Amérique du Nord
	Amérique du Sud
	Asie
	Europe
	Océanie
Selon vous, quel est votre niveau de maîtrise de la matière abordée dans l'activité pédagogique concernée par cette évaluation ?	Néant
	Novice
	Confirmé
	Expert
A quelle fréquence jouez vous à des jeux d'évasion (pédagogique ou non) ?	Jamais
	Rarement
	Régulièrement

Figure J.1: Questionnaire Evscape : questionnaire démographique

Questionnaire de motivation Evscape					
	Fortement en désaccord	**En désaccord**	**Neutre**	**D'accord**	**Fortement d'accord**
Je suis enthousiaste à l'idée de réaliser l'ac- L tivité pédagogique pratique à laquelle j'ai été assigné.	☐	☐	☐	☐	☐
Je suis intéressé(e) par la matière enseignée L au travers de l'activité pédagogique qui m'est proposée.	☐	☐	☐	☐	☐
Je pense que la matière enseignée au travers L de l'activité pédagogique qui m'est proposée est difficile à appréhender.	☐	☐	☐	☐	☐

Figure J.2: Questionnaire Evscape : questionnaire de motivation

Questionnaire d'experience utilisateur Evscape					
	Fortement en désaccord	En désaccord	Neutre	D'accord	Fortement d'accord
Je ne me suis pas soucié(e) des évènements externes à l'activité pratique à laquelle j'ai par- ticipé	☐	☐	☐	☐	☐
J'ai été captivé(e) par l'activité pratique depuis le départ.	☐	☐	☐	☐	☐
Je pense que le niveau de défi de l'activité pratique était adéquat (ni trop facile, ni trop dif- ficile).	☐	☐	☐	☐	☐
Je recommanderai cette activité pratique à d'autres étudiants de premier cycle en infor- matique.	☐	☐	☐	☐	☐
Je souhaite faire plus d'activités pratiques similaires dans le cadre de ma formation en in- formatique.	☐	☐	☐	☐	☐
Je pense que la durée de l'activité pratique était adéquate.	☐	☐	☐	☐	☐
Je me suis senti(e) viscéralement impliqué(e) dans l'activité pratique.	☐	☐	☐	☐	☐
Je me suis senti(e) viscéralement impliqué(e) dans l'activité pratique.	☐	☐	☐	☐	☐
J'ai relevé des incohérences (ou erreurs) au cours de l'activité pratique qui m'a été présentée	☐	☐	☐	☐	☐
J'étais tellement impliqué(e) dans l'activité pratique que j'ai perdu la notion du temps.	☐	☐	☐	☐	☐
Je pense que l'activité pratique proposée est une méthode d'enseignement adéquate pour cette matière.	☐	☐	☐	☐	☐
Je pense que la conception de l'activité pratique est attrayante.	☐	☐	☐	☐	☐
J'ai trouvé du plaisir dans l'activité pratique proposée.	☐	☐	☐	☐	☐
Je pense que les tâches proposées dans l'activité pratique étaient amusantes.	☐	☐	☐	☐	☐
Je pense que les tâches proposées dans l'activité pratique étaient variées.	☐	☐	☐	☐	☐
Je pense que certains éléments proposés dans l'activité pratique étaient non essentiels à l'acquisition des savoirs visés.	☐	☐	☐	☐	☐
Je pense que l'activité pratique était une expérience stressante.	☐	☐	☐	☐	☐
Je pense que tous les participants ont été impliqués de manière équitable dans l'activité pratique.	☐	☐	☐	☐	☐

Figure J.3: Questionnaire Evscape : questionnaire d'expérience utilisateur

Questionnaire d'experience utilisateur Evscape					
Je pense que l'activité pratique était inutilement complexe.	☐	☐	☐	☐	☐
J'ai pu faire le lien entre la séance théorique et l'activité pratique proposée.	☐	☐	☐	☐	☐
A l'issue de l'activité pratique, je souhaite en savoir plus sur la matière enseignée.	☐	☐	☐	☐	☐
Au cours de l'activité pratique, j'ai pu rapidement me rendre compte de mes erreurs ou réussites.	☐	☐	☐	☐	☐
Au cours de l'activité pratique, j'ai pu compter sur l'aide des autres participants pour augmenter mes connaissance dans la matière enseignée.	☐	☐	☐	☐	☐
J'estime que l'activité pratique m'a permis de mettre en pratique mes connaissances théoriques.	☐	☐	☐	☐	☐
e pense que l'activité pratique à laquelle j'ai été assigné(e) m' a permis de mieux apprendre que si j'avais été affecté(e) à l'autre.	☐	☐	☐	☐	☐
Je trouve que le jeu prend en charge les interactions sociales entre joueurs.	☐	☐	☐	☐	☐

Sur base de mon expérience scolaire personnelle , je qualifierai mon expérience avec l'activité pédagogique proposée comme étant :

Mauvaise
Suffisante
Bonne
Excellente
Exceptionnelle

Figure J.4: Questionnaire Evscape : questionnaire d'expérience utilisateur (suite)

Appendix K

Consent form

Évaluer l'impact des jeux d'évasion éducatifs sur l'apprentissage de l'informatique au premier cycle universitaire
[Nom Superviseur - Nom Chercheur]

Introduction

Vous êtes invité à participer à un projet de recherche dans le cadre d'un travail de recherche sur le thème de la pédagogie en informatique de [Nom Chercheur] sous la supervision (Nom Superviseur) en faculté d'informatique de l'Unamur.

Ce projet de recherche est destiné à évaluer l'impact des jeux d'évasion éducatifs sur l'apprentissage de l'informatique.

Avant que vous acceptiez de participer à cette étude, vous devez connaître l'organisation mise en place pour votre participation ainsi que les éventuels inconvénients et avantages liés à votre participation afin de pouvoir prendre une décision informée. C'est ce que l'on appelle donner un « consentement éclairé ».

Veuillez lire attentivement ces quelques pages d'information et poser toutes les questions que vous souhaitez à l'investigateur ou à la personne qui le représente.

Si vous participez à cette recherche, vous devez savoir que :

- Cette recherche est mise en œuvre après évaluation par le comité d'éthique [Université].
- Votre participation est volontaire et nécessite la signature d'un consentement. Même après l'avoir signé, vous pouvez mettre un terme à votre participation en informant les investigateurs. Votre décision de ne pas ou de ne plus participer à l'étude n'aura aucun impact sur vos relations avec les investigateurs.
- Aucun frais ne vous sera facturé pour l'utilisation des outils mis à votre disposition spécifiquement à cette étude.
- Les données recueillies à cette occasion sont confidentielles et votre anonymat est garanti lors de la publication des résultats.
- Une assurance a été souscrite au cas où vous subiriez un dommage lié à votre participation à cette recherche.
- Vous pouvez toujours contacter les investigateurs si vous avez besoin d'informations complémentaires.
- La durée totale de l'expérimentation est de 6h30. Elle se prolongera un mois plus tard pour une durée de 30 minutes.
- La participation complète à cette étude vous apportera un point bonus dans le cadre du cours dont la dénomination est [intitulé du cours].

Ces points sont détaillés en annexe sous la rubrique « Droits et protection du participant à une recherche clinique ».

Si vous participez à cette recherche, nous vous demandons :

- de collaborer pleinement au bon déroulement de cette recherche;
- de ne rien cacher comme information au sujet de vos avis et ressentis;
- de ne divulguer aucune information, à quelconque tiers, qui pourrait compromettre les résultats et conclusions de cette expérimentation (protocole, questions posées et autres).

Formulaire de consentement - Évaluer l'impact des jeux d'évasion éducatifs sur l'apprentissage de l'informatique au premier cycle universitaire

Figure K.1: Questionnaire de consentement - (source : `https://www.erasme.ulb.ac.be/sites/default/files/files/articles/2017/modele_dic_tfe_etude_interventionnelle_201701.docx`)
Texte de couleur = variable

Description du protocole de l'étude

Cette étude se justifie par le fait que le marché de l'emploi vit actuellement une pénurie de profils informatiques qualifiés. Il est primordial de rendre les études d'informatique plus attrayantes afin d'attirer de nouveaux profils et ainsi répondre aux demandes du marché de l'emploi.

6 étudiants de premier cycle universitaire en informatique participeront à cette expérimentation.

Vous serez assigné aléatoirement au travers de deux groupes. Les membres de groupe contrôle participeront à une activité de travaux pratiques classique. Les membres du groupe expérimental quant à eux participeront à un jeu d'évasion éducatif spécifiquement conçu pour l'apprentissage de l'informatique.

Nous récolterons des données par rapport à votre motivation, votre expérience utilisateur, vos caractéristiques démographiques et votre évolution d'apprentissage entre la situation pré et post activité.

L'expérimentation se déroulera de la manière suivante:

1. Questionnaire démographique [10 minutes]
2. Cours magistral [120 minutes]
3. Repos [15 min]
4. Annonce des groupes [5min]
5. Questionnaire de motivation [15 min]
6. Test de vos connaissances [30 min]
7. Activité (varie selon le groupe auquel vous êtes assigné)[120 min]
8. Repos [15 min]
9. Test de vos connaissances [30 min]
10. Questionnaire d'expérience utilisateur [15 min]
11. Débriefing et discussion de groupe [15 min]

[1 mois plus tard]

12. Test de vos connaissances [30 min]

Formulaire de consentement - Évaluer l'impact des jeux d'évasion éducatifs sur l'apprentissage de l'informatique au premier cycle universitaire

Figure K.2: Questionnaire de consentement - (source : `https://www.erasme.ulb.ac.be/sites/default/files/files/articles/2017/modele_dic_tfe_etude_interventionnelle_201701.docx`)
`Texte de couleur = variable`

Consentement éclairé

Je déclare que j'ai été informé sur la nature de l'étude, son but, sa durée, les inconvénients éventuels liés à la participation à l'étude et ce que l'on attend de moi.

J'ai eu suffisamment de temps pour y réfléchir et en parler avec une personne de mon choix.

J'ai eu l'occasion de poser toutes les questions qui me sont venues à l'esprit et j'ai obtenu une réponse satisfaisante à mes questions.

J'ai compris que ma participation à cette étude est volontaire et que je suis libre de mettre fin à ma participation à cette étude sans que cela ne modifie mes relations avec les investigateurs.

J'ai compris que des données me concernant seront récoltées pendant toute ma participation à cette étude et que les investigateurs se portent garant de la confidentialité de ces données (cfr rubrique « Garanties de confidentialité » dans l'annexe « Droits et protection du participant »).

J'ai reçu une copie de l'information au participant et du consentement éclairé.

[Nom, Prénom, date et signature du volontaire].

Je soussigné, **[Nom et prénom Chercheur]** , investigateur, confirme avoir fourni oralement les informations nécessaires sur l'étude et avoir fourni un exemplaire du document d'information au participant.

Je confirme qu'aucune pression n'a été exercée pour que le volontaire accepte de participer à l'étude et que je suis prêt à répondre à toutes les questions supplémentaires, le cas échéant.

[Nom, prénom, date et signature de l'investigateur]

Formulaire de consentement - Évaluer l'impact des jeux d'évasion éducatifs sur l'apprentissage de l'informatique au premier cycle universitaire

Figure K.3: Questionnaire de consentement - (source : `https://www.erasme.ulb.ac.be/sites/default/files/files/articles/2017/modele_dic_tfe_etude_interventionnelle_201701.docx`**)**
Texte de couleur = variable

Droits et protection du participant

Participation volontaire

Avant de signer, n'hésitez pas à poser toutes les questions que vous jugez utiles. Prenez le temps d'en parler à une personne de confiance si vous le souhaitez. Votre participation à l'étude est volontaire : ceci signifie que vous avez le droit de ne pas y participer ou de vous retirer sans justification même si vous aviez accepté préalablement d'y participer. Votre décision ne modifiera en rien vos relations avec les investigateurs.

Si vous acceptez de participer à cette étude, vous signerez le formulaire de consentement éclairé. Un des investigateurs signera également ce formulaire et confirmera ainsi qu'il vous a fourni les informations nécessaires sur l'étude. Vous recevrez l'exemplaire qui vous est destiné.

Aucun dédommagement pour le temps consacré à votre participation ou les inconforts liés aux examens de l'étude n'est prévu à l'exception d'un point bonus dans le cours mentionné précédemment.

Garantie de confidentialité

Votre participation à l'étude signifie que vous acceptez que les investigateurs recueillent des données vous concernant et les utilisent dans un objectif de recherche.

Vous avez le droit de demander aux investigateurs quelles sont les données collectées à votre sujet et quelle est leur utilité dans le cadre de l'étude. Vous disposez d'un droit de regard sur ces données et le droit d'y apporter des rectifications au cas où elles seraient incorrectes.

Les investigateurs ont un devoir de confidentialité vis-à-vis des données collectées. Ceci veut dire qu'ils s'engagent non seulement à ne jamais divulguer votre nom dans le cadre d'une publication ou d'un exposé mais aussi qu'ils prendront toutes les mesures indispensables à la protection de vos données (protection des documents sources, code d'identification, protection par mot de passe des bases de données créées). Les données personnelles collectées ne contiendront pas d'association d'éléments qui puissent permettre de malgré tout vous identifier.

Quand l'étude sera terminée (après validation des résultats et publication éventuelle), les investigateurs s'engagent à détruire la base de données qui contient votre code d'identification, vos nom, prénom, de sorte qu'il ne sera plus possible de faire le lien entre les données recueillies pendant l'étude et votre identité.

Assurance

Nous ne pouvons exclure aucun risque, si minime soit-il. Le promoteur assume, même sans faute, la responsabilité du dommage causé au participant (ou à ses ayants droit) et lié de manière directe ou indirecte aux expériences réalisées. Dans cette optique, le promoteur a souscrit un contrat d'assurance.

Contact

Si vous avez besoin d'informations complémentaires, mais aussi en cas de problème ou d'inquiétude, vous pouvez contacter l'investigateur suivant : **[Nom, Prénom, numéro de téléphone, email]**.

Formulaire de consentement - Évaluer l'impact des jeux d'évasion éducatifs sur l'apprentissage de l'informatique au premier cycle universitaire

Figure K.4: **Questionnaire de consentement - (source :** `https://www.erasme.ulb.ac.be/sites/default/files/files/articles/2017/modele_dic_tfe_etude_interventionnelle_201701.docx`**)**
Texte de couleur = variable

Appendix L

UEQ questionnaire

Dites-nous maintenant ce que vous pensez de notre produit (une seule réponse possible par qualité/défaut).

	1	2	3	4	5	6	7		
Agaçant	○	○	○	○	○	○	○	Agréable	1
Incompréhensible	○	○	○	○	○	○	○	Compréhensible	2
Moderne	○	○	○	○	○	○	○	Sans fantaisie	3
Appropriation simple	○	○	○	○	○	○	○	Appropriation compliquée	4
Apporte de la valeur	○	○	○	○	○	○	○	Peu de valeur ajoutée	5
Ennuyeux	○	○	○	○	○	○	○	Captivant	6
Inintéressant	○	○	○	○	○	○	○	Intéressant	7
Imprévisible	○	○	○	○	○	○	○	Prévisible	8
Rapide	○	○	○	○	○	○	○	Lent	9
Original	○	○	○	○	○	○	○	Conventionnel	10
Rigide	○	○	○	○	○	○	○	Facilitant	11
Bien	○	○	○	○	○	○	○	Médiocre	12
Compliqué	○	○	○	○	○	○	○	Simple	13
Repoussant	○	○	○	○	○	○	○	Attractif	14
Habituel	○	○	○	○	○	○	○	Avant-gardiste	15
Désagréable	○	○	○	○	○	○	○	Agréable	16
Sécurisant	○	○	○	○	○	○	○	Insécurisant	17
Stimulant	○	○	○	○	○	○	○	Soporifique	18
Répond aux attentes	○	○	○	○	○	○	○	Ne répond pas aux attentes	19
Inefficace	○	○	○	○	○	○	○	Efficace	20
Clair	○	○	○	○	○	○	○	Déroutant	21
Non pragmatique	○	○	○	○	○	○	○	Pragmatique	22
Sobre	○	○	○	○	○	○	○	Surchargé	23
Attrayant	○	○	○	○	○	○	○	Rébarbatif	24
Sympathique	○	○	○	○	○	○	○	Inamical	25
Conservateur	○	○	○	○	○	○	○	Innovant	26

Figure L.1: Questionnaire UEQ - (source : https://www.ueq-online.org/)