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Towards a Model of Play: an Empirical Study

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Abstract: This paper describes an empirical work dedicated to the design and analysis of the uses of *Tamagocours*, a collaborative multiplayer online game. *Tamagocours* has been designed to address an educational challenge: teaching the rules (ie. copyright) that comply with the policies for the use of digital resources in an educational context. The challenge lies in the fact that the subject is complex, the time dedicated to this course is short, students are not motivated enough by the topic, and few educators are available. The design of the game and the analysis of its use are based on a theoretical model (Russian Matryoschka Model of Play) adapted from the Theory of Didactical Situations (Brousseau, 1998). Rather than the game itself, we consider the play, the situation established within the game. This situation enables *epistemic interactions* (ie. interactions involved in the learning process and called *digital epistemic play*). We distinguish two layers of play. The first layer is dedicated to action (ie. interactions between students and the game). The second layer of play is devoted to formulation of the applied strategies and discussions which enable the validation of the latter strategies. Another layer of interaction consists in leaving the situation of play and in a debriefing conducted by an educator.
Tamagocours is based on a metaphor; a *tamagotchi* which needs to be fed with digital educational resources. The gameplay consists in (1) choosing a resource, (2) chatting with partners in order to discuss its relevance and (3) feeding the *Tamagocours* with this resource. The feedback provided by the *Tamagocours* character depends on the characteristics of the resource. One which complies with the policies enables the player to earn points, otherwise, the *Tamagocours* could be killed if fed too many inappropriate resources.
Our methodology is based on recording and analyzing the digital traces produced by a group of 25 students (8 teams) who played during a 90 minutes session. The students' discussions where coded and the digital traces enabled us to draw a behavioural model of the students.
This paper aims at discussing the relevance of our model in drawing a behavioural model of the students by identifying *Action patterns* and describing the strategies of the players/learners.

Keywords: Game Based Learning, Multiplayer Serious Games, Tamagocours, Digital Traces Analysis, RM2P Model of Play

Introduction

Despite an enthusiastic debate and a growing body of research dedicated to game-based learning, we still lack theoretical models to analyze the use of digital games designed for educational purposes. Therefore, the aim of this paper is to propose a model of play based on the Theory of Didactical Situations (Brousseau, 1998). This model, named Russian Matryoschka Model of Play (RM2P), is discussed within the frame of an empirical research on the use of *Tamagocours*, a collaborative multiplayer online game dedicated to learning the terms of use of digital resources in an educational context.
In this paper, we present (1) the game *Tamagocours* and its pedagogical objectives, (2) some arguments in favour of focusing on the play rather than on the game itself, (3) a model which describes two layers of play embedded in a third layer, the learning situation, (4) the methodology of our research, based on the analysis of digital traces produced by 25 pre-service teachers using Undertracks (Bouhineau & al., 2013), a tool used to collect, analyze and visualize digital traces, and (5) a discussion about the RM2P model considering the results that emerged from this study.

1. Tamagocours

In France, pre-service teachers have to pass a certificate named C2i2e (informatics and internet certificate for teachers) before qualifying for a position. Being able to follow the rules (ie. copyright) that comply with the terms of use of digital educational resources is one of the C2i2e-acquired competences (Bulletin Officiel de l'Education Nationale, 2011). At the ENS of Lyon, most students are

focused on their majors and do not feel motivated by the issues addressed by C2i2e. In addition, the teaching time dedicated to the certificate is short, the students are not available all at the same time, and their number is high (200 participants). Therefore, we decided to address this educational challenge by designing an online and asynchronous teaching program “Tamagocours”, an online multiplayer game (Sanchez, 2013).
The game *Tamagocours* (see fig. 1) is based on a metaphor; a *tamagotchi* which needs to be fed with digital educational resources. The gameplay consists in (1) choosing a resource on the shelf and the format under which this resource will be used (collective projection, photocopy, post on the intranet website…) then preserving it in the fridge, (2) chatting with partners in order to discuss the relevance of the chosen resource and (3) feeding this resource to a character (the *Tamagocours*). The player/learner can access to a legal library that contains the links to the legislation regarding the use of different resources (digital or not) for education. The feedback provided by the character *Tamagocours* depends on the legal characteristics (creative commons, copyrighted …) and the educational distribution method of the resource. If the resource chosen complies with the copyright policies, it enables the character to stay healthy (green colour) and the player/learner to earn points. Otherwise, the Tamagocours gets sick (red colour) and dies if fed with too many inappropriate resources. The team can replay each level they have lost indefinitely until they reach the following level. The back office of the game enables researchers to modify the gameplay in terms of number of students per team and level of difficulty (number of lives, number of good answers required to achieve a level, maximum number of resources each player can use to feed the *Tamagocours*…). The teams of players are created automatically and randomly. Each player of each team becomes an anonymous avatar (Joe the cook, Lea the waitress…) and does not know with whom he/she is playing nor within which group, all groups have the same avatars.

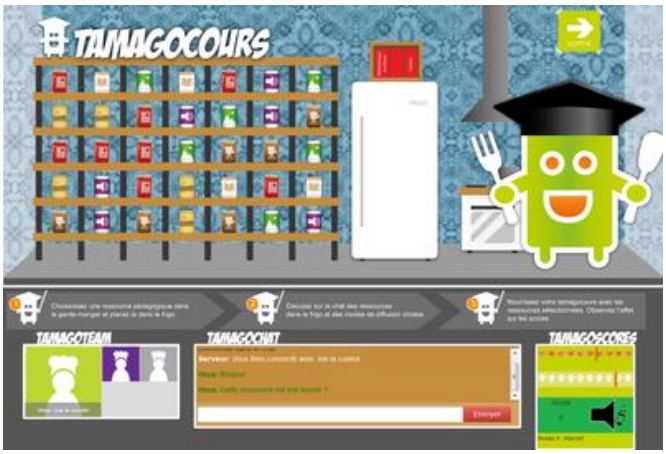

Figure 1: The Tamagocours Interface

2. Serious Play vs Serious Game

Rather than considering the game itself, our work considers the play, the situation designed with the game and the interactions that emerge from this situation. Therefore, from a Piagetian point of view, we consider that learning results from the adaptation of the learner to the game and thus, from the interactions within a given situation. These interactions are called epistemic interactions (Ohlsson, 1995) and the terms “digital epistemic play” (E Sanchez, forthcoming) are used rather than “serious game”.

We consider games as metaphors. The educational value of a game does not lie in its capacity to represent a given situation but in the authenticity of the interactions enabled by the game. As a result, *Tamagocours* is not a reliable depiction of a classroom but a metaphor of the learning objectives: making a relevant decision when it comes to deciding what type of digital resources should be chosen in a specific teaching context. The game designers found the feeding metaphor based on a *tamagotchi* to be particularly relevant regarding this issue.

Tamagocours enables the learners/players to live a phenomenological experience. Indeed, he/she has the freedom to take decisions and to perform according to his understanding of the situation. The continuous feedbacks provided by the game help the players/learners assess the consequences of their activity. Therefore, the situation consists of a space of reflexivity which offers the

players/learners the opportunity to evaluate their way of thinking and behaving throughout the game, to recognize success and failures, and to learn from them.

3. A Russian Matryoschka Model of Play

The design of *Tamagocours* is based on the Theory of Didactical Situations (Brousseau, 1998; Gonçalves, 2013). This model of play describes different layers of play placed one inside the other like Russian Matryoschka dolls. A first layer of play (*Play 1*) consists in a situation of *action (*ie. interactions between the students and the game). The player/learner interacts with the game, adjusts individually his/her decisions, and shapes a strategy according to the feedbacks provided by the game. This situation is a first layer of play (see fig.2).

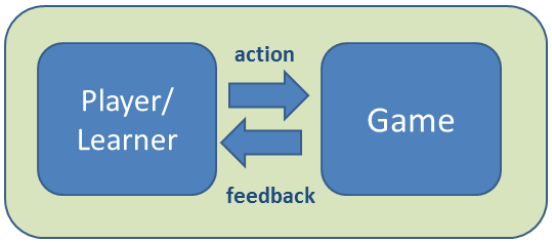

Figure 2: First Layer of Play – *Play 1*

Play 2, a second layer of play (fig. 3) consists in a *formulation* and *validation* situation (Balacheff, Cooper, & Sutherland, 1997). The students' discussions in the chat enable the formulation of strategies that they apply during the game. Therefore, the validity of these strategies is collaboratively established according to the experience gained from the individual interactions within *Play 1 layer*.

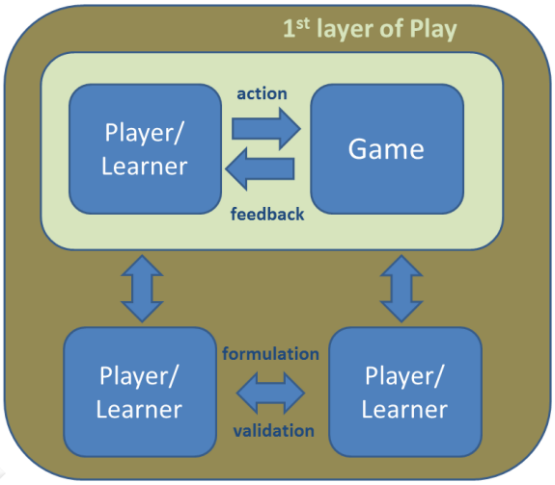

Figure 3: Second Layer of Play - *Play 2*

Play 1 and *Play 2* constitute an adidactical learning situation (Ibid.). The teaching objectives are hidden and the players/learners perform according to their understanding of the situation rather than to the expectations of the teacher. Another layer emerges when the teacher/trainer is involved in the situation. Thus, the learning objectives become explicit and the players/learners participate in a debriefing session based on the spelling out of the experience gained with the game. This layer, named *didactical situation* (Ibid.), is also characterized by the change of the knowledge status. The situated knowledge dedicated to win the game becomes more universal and is validated by an official external source, the teacher/trainer. Therefore, by reaching this layer the player/learner gets out of the play.

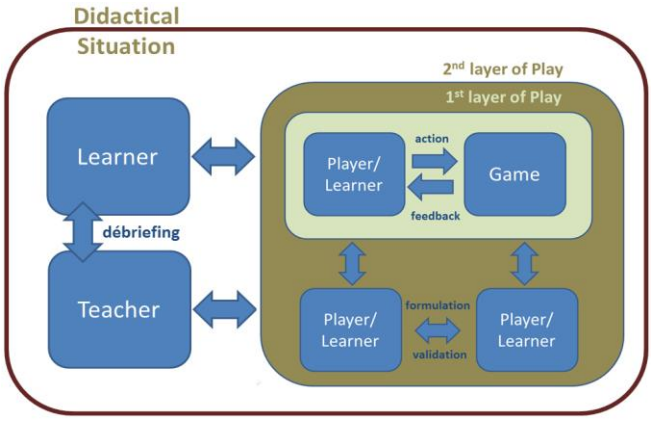

Figure 4: A Russian Matryoschka Model of Play

In the following we discuss the relevance of the RM2P model and we describe the strategies of the *Tamagocours* players.

4. Methodology

The methodology of research is based on a Design-Based Research approach (Design-Based Research Collective, 2003). It combines design and analysis within an iterative process carried out in ecological settings (ie: in real learning context) implying various stakeholders: researchers, programmers, designers, students, tutors, pedagogical engineers, administrative representatives and a legal expert.

The methodology is also based on recording and analyzing the digital traces produced by 25 pre-service teachers who played during a 90 minutes face to face session: a first group of 16 students (5 teams) and a second group of 9 students (3 teams). The students were playing in the same computer room and they were asked to use the chat in case they need to discuss with their partners. In the following, each team of players is coded GRn for group number n.

For the analysis of the digital traces we used *Undertracks* (Bouhineau et al., 2013), an open web platform developed by the research team MeTAH from LIG (Laboratoire Informatique de Grenoble) dedicated to collecting, analyzing, sharing and visualizing digital traces produced by recording interactions with Technology Enhanced Learning (TEL) systems (Romero and Ventura, 2007). Undertracks enables to mutualize experimental research in TEL Systems, *i.e*. to mutualize data and also treatments and analysis processes. Our purpose is to build analysis processes that can be reused with similar data such as logfiles of actions and message coding for the game *Tamagocours*. To carry out such analysis, we first prepare the data stored in *Tamagocours* database: sorting, renaming columns. Then these data are enriched by adding links or semantic information (such as coding the chat messages). The data are then exported in CSV format in order to be uploaded and integrated on Undertracks.
In this paper we focus on two sets of indicators for the analysis of the data. (1) *Action patterns* (Romero & Ventura, 2007; Srikant & Agrawal, 1996) showing that the player is involved in an action situation (*Play 1*) and (*Play 2*) *Coding* of the chat messages that are displayed in different categories. These categories are related to the *Formulation* and *Validation* situations (*Play 2*).

Coding of the chat

The students' messages in the chat where coded by three researchers, the differences were minors (80% of agreements) and were mainly about the observations: do they relate to the game in general, to the resource handled or to an action in the game? The differences were discussed in order to have a consensus on the interpretation of the discussions (Table 1) results from this consensus on the coding. The different categories are illustrated with examples of the messages in the chat. We coded F for "Formulation" used for a statement of a legal rule or of a part of it, H for "Hypothesis": a hypothesis on a legal rule, Q for "Question ": a question on a legal rule or a resource, O for "Observation": an observation on a legal rule or a particular resource, OJ for "Observation about the game" and NC for "Not coded" corresponding to exclamations or presentations ("*Who is martin?")*. H, Q and O correspond with the Validation phase in Figure 3. The coding of the chat messages allows us to determine whether or not players are involved in *Play 2*: chat messages coded F or V are indicators of *Play 2*.

Table 1: Coding categories for the discussions in the chat.

Coding categories	Explanation	Examples		
Formulation = F	Statement of a legal rule	*10% of a book, 30% of a newspaper are authorized copies.*	*Well, we do not give it the radio show of "France inter"*	*because it's a radio show*
Validation = H	Hypothesis on a legal rule or a resource and/or its used format	*« journal de l'enseignement », from 1898 it should be in the public domain now*	*otherwise, it is the fact that it is printed copies that he can't digest*	*Clearly, the « nouvel obs » in collective projection = not good*
Validation = Q	Question on a legal rule or a resource	*Why is 3s of « on va tous y passer » not working?*	*What is the rule for the video?*	*What do you think of "mémoires d'immigration" bellow?*
Validation = O	Observation on a legal rule or a particular resource	*I would like to test the CFC conditions*	*Ah, a Figaro in the public domain.*	*I photocopied the book on immigration*
Other = OJ	Observation about the game	*after putting something in the fridge, you should move your resource in the mouth of the tamagotchi*	*You could put something in the fridge?*	
Other = NC	Not coded	*I can see*	*Who is martin?*	*mium mium*

Action patterns traces

Undertracks produces chronograms that enable the visualization of the actions within the play for each player (see figure 1). The different actions traced are the following: *addToFridgeAction, feedTamagoActionBad, feedTamagoActionGood, chatAction, helpAction, removeFromFridgeAction, showItemAction and tutoAction*. We define *Action patterns* (Srikant and Agrawal, 1996; Romero and Ventura, 2007) which consists in a set of actions that aims at a specific objective (eg. feeding the Tamagocours with a digital resource) and show a specific strategy.

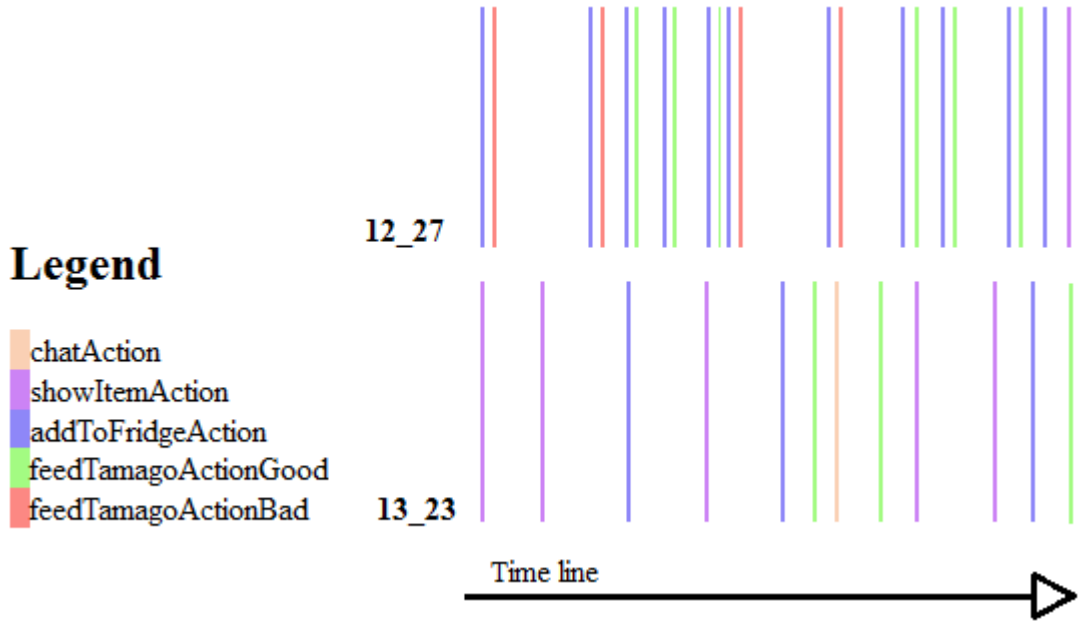

Figure 1: Undertracks chronogram visualization operator

Figure 1 shows that two players named 12_27 (player 27, group 12) and 13_23 (player 23, group 13) are playing (*Play 1*) in a very different way. Player 27 has a very low level strategy: feeding the *Tamagocours* quickly without consulting the characteristics of the resource selected (*showItemAction* not present), sometimes succeeding (*feedTamagoActionGood*) and sometimes failing (*feedTamagoActionBad)*. On the contrary, Player 23 seems to be more cautious: first checking the resource characteristics (*showItemAction*) then choosing to put it or not into the fridge (*addToFridgeAction*) and feeding correctly the *Tamagocours* (*feedTamagoActionGood*).
This extract illustrates two main *Action patterns*: Pattern 1:"*addToFridge-feedTamago*" and Pattern 2: "*showItem-addToFridge-feedTamago*" which indicates respectively 2 strategies related to *Play 1* layer: Strategy 1: "*Choice*" and Strategy 2 "*Checked choice*". More patterns can be found especially the one using chat messages between the interaction actions.

5. Results & Discussion

In the following, we focus on the analysis of the chat messages in order to discuss if the players/learners are involved in *Play 2* and on the analysis of *Action patterns* in order to characterize the strategies followed by the players/learners involved in *Play 1*.

Analysis of the chat messages

In Table 2 we have collected the number of occurrences of each coding category (F, H, Q, O, OJ, NC). The column V is the cumulative frequencies of H, Q and O which allows us to have the total number of validation sentences regarding the *Validation* in *Play 2*. A first observation is that GR13 and group number GR35 have exchanged very few messages compared to other groups. They have 2 messages dedicated to *Formulation* and 2 to *Validation*. GR12 and GR33 have a similar number of messages (approximately 70) and very few *Formulation* messages (4 and 3 respectively) compared to groups 11, 14, 15 and 34. Also, GR12 has 4 *Validation* messages while GR33 has 25, GR12 has 47 observations about the game while GR33 has 19; as for not coded messages (NC) they have 16 and 27 respectively. These results suggest that GR12 spoke more about the game and very few about legal issues while GR33 asked more questions and made more hypothesis and observations on the resources. Therefore we consider that GR33 is involved in *Play 2* (highlighted with patterns in Table 2) while GR12 is mainly involved in *Play 1*. Groups 11, 14, 15 and 34 are clearly involved in *Play 2* (highlighted in Table 2).

Table 2: Breakdown of the coding of the discussions in the chat

Coding Cat Group Id	F	H	Q	O	V	OJ	NC	Total
11	**11**	11	10	12	**33**	32	13	**89**
12	**4**	0	1	3	**4**	47	16	**71**
13	**0**	1	1	0	**2**	9	3	**14**
14	**12**	30	13	40	**83**	50	31	**176**
15	**13**	13	17	17	**47**	54	36	**150**
33	**3**	4	7	14	**25**	19	27	**74**
34	**25**	12	27	70	**109**	63	51	**248**
35	**0**	0	0	2	**2**	14	18	**34**
Total	**68**	**71**	**76**	**158**	**305**	**288**	**195**	**856**

This quantitative analysis can be enriched by a qualitative analysis of the chat messages. We study below excerpt from one of the groups involved in *Play 2* more thoroughly. This excerpt from GR34 comes 4 minutes after the beginning of the game where players/learners were looking individually at resources and sending messages to present themselves.

Table 3: Message excerpt from group 34

Group Id	User Id	Coding	Message Translated
34	40	O	Take a look at "à l'école des stéréotypes"
34	42	F	Be careful about the authorized number of pages
34	40	Q	Do we keep it or not?
34	42	O	Ok, 25 pages used from “l'école des stéréotypes"
34	42	O	It's a digital edition
34	41	Q	So we put it in the fridge, don't we?
34	40	O	yes
34	42	Q	Wait, is there no rule?
34	42	O	It's under copyright
34	40	Q	A rule??
34	42	O	Not as educational exception !!
34	41	F	Oh then no if it's digital, we don't have the right.
34	40	F	Yes it's copyrighted
34	41	F	The board clearly says that we are not authorized to use digital editions
34	42	O	Yeah
34	42	O	But it's a book originally
34	40	O	It's a paper edition right?
34	42	O	It's a scan
34	42	F	So it's authorized
34	42	F	But number limited to 5 pages !
34	42	NC	Sorry
34	40	O	ok so No

Player 40 consults the resource "à l'école des stéréotypes" and asks the others to look at it, a debate starts. The players first notice that they have to check the number of pages used, then by paying more attention to the synthesis table from the legal help section in the game, Player 42 notice that they can only use 5 pages since it is a scan of a book (*It's a scan, So it's authorized, But number limited to 5 pages !*). We can see in this dialog alternation from F to Q and O then back to F. The formulations are made by players 42 and 41. Player 40 seems mainly in validation state by asking questions or making observations but then makes a conclusion “Ok so no”, which ended the debate. This excerpt shows very clearly a collaborative discussion and reflexion inside the game, leading to a consensus on rejecting a resource not compliant with the legal rules. We are undoubtedly witnessing a *formulation* and *validation* situation (*Play 2*).

By adding the information from the logfile to these chat results, we can notice that this dialog took 4 min 20s, and used only 3 actions: *showItemAction, chatAction* and *helpAction*. All 8 *showItemAction* occurrences where about the resource "à l'école des stéréotypes" from all 3 players and *helpAction* was from player 40 reading about Creative Commons licence. Along the game, player 40 seems to be the “leader” by asking others to look at resources found on the shelf and by having an organised method of looking to the items on the shelf (“*let’s resume our items one by one*”, “*we must find another one now*”), in other parts of the data, he/she is taking decisions about giving resources to the *Tamagocours*, is consulting the legal library (20 Help actions, see Table 4) and is feeding it with correct items (5 FeedTamagoGood actions, see Table 4).

All the teams have been involved in *Play 2* layer. However, if some teams are deeply involved in discussions about the legal rules that should be taken into account to feed the *Tamagocours* others have shorter discussions. As a result, the knowledge that should be learnt is not as deeply mobilized among the different teams.

Analysis of the Action patterns

We present here the quantitative results for each player related to the number of actions in the game session and the number of occurrences of *Action patterns*.

Table 4 shows the number of actions achieved to win the five levels of the game and the number of occurrences of Patterns 1 and 2 for each player within each group. A first finding is that the duration of a game session is very different from one group to another, the fastest group (GR12) tooks only 19 minutes and succeeded, the slowest group (GR15) took 1 hour and 10 minutes and failed at the fourth level. The number of actions is correlated with the duration. GR12 failed twice level 1 and level 4; GR33 failed twice level 2 and four times level 3; GR13 failed four times level 3, the other groups had more fails but the slowest groups (GR15 and GR34) had failed at level 3 and 4 respectively. The details of the log files and the number of actions show that GR15 took time to look at the details of the available resources (*showItem*) and to consult the legal library (*help*). In spite of these actions, GR15 failed many times by choosing the wrong resources to feed the *Tamagocours* (*feedBadItem*). On the other hand (GR34) took time but succeeded without failing to a level, making most of time "good" choices, till level 3 and level 4 stayed unaccomplished.

In this paper, we are focusing on the 2 patterns previously mentioned: Pattern 1:"*addToFridge-feedTamago*" related to Strategy 1: "*Choice*" (the player/learner performs actions of feeding the *tamagotchi* without checking the resources characteristics) and Pattern 2 "*showItem-addToFridge-feedTamago*" related to Strategy 2 "*Checked choice*" (the player/learner performs actions of feeding the *tamagotchi* by checking the resources characteristics before). In order to have all results showing these two strategies, we have also retrieved the patterns including one or two chat actions or help actions among the "*showItem-addToFridge-feedTamago*" actions or "*addToFridge-feedTamago*" actions.

Table 4: Number of *Actions* and Action *Patterns* by Group and by Player

Duration	Group	Summary of the levels played	User id	feed BadItem	feed GoodItem	help	showItem	chatAction	TotalAction	Pattern Choice	Pattern Checked choice
00:41:23	11	1 2 2 3 3 4 4 4 4 4 4 5 5	**GR11**	**30**	**47**	**57**	**441**	**92**	**872**	**17**	**88**
			11_15	10	4	21	71	24	191	7	11
			11_19	6	23	20	155	11	267	4	32
			11_22	3	10	12	112	27	198	3	15
			11_24	11	10	4	103	30	216	3	30
00:18:56	12	1 1 1 2 2 3 4 4 4 5	**GR12**	**75**	**36**	**7**	**22**	**72**	**283**	**102**	**8**
			12_13	51	4	3	2	32	60	5	1
			12_18	2	9	1	4	36	85	20	1
			12_26	8	8	1	16	2	57	19	6
			12_27	14	15	2	0	2	81	58	0
00:29:23	13	1 2 3 3 3 3 3 4 5	**GR13**	**24**	**42**	**12**	**93**	**15**	**310**	**32**	**51**
			13_21	14	19	6	38	10	163	30	17
			13_23	10	23	6	55	5	147	2	34
00:45:19	14	1 2 2 3 3 4 5 5	**GR14**	**17**	**42**	**36**	**230**	**178**	**609**	**4**	**73**
			14_16	3	22	13	70	80	222	0	32
			14_20	5	10	7	99	63	214	1	19
			14_25	9	10	16	61	35	173	3	22
01:09:43	15	1 2 3 3 3 4 4	**GR15**	**16**	**30**	**39**	**175**	**151**	**598**	**28**	**38**
			15_14	10	15	15	69	55	212	0	18
			15_17	3	6	12	40	54	199	27	9
			15_8	3	9	12	66	42	187	1	11
00:27:36	33	1 2 2 2 3 3 3 3 4 5	**GR33**	**28**	**33**	**3**	**100**	**74**	**314**	**23**	**53**
			33_37	11	12	1	46	27	123	2	25
			33_38	11	12	2	32	35	118	9	19
			33_39	6	9	0	22	12	73	12	9
00:55:46	34	1 2 3 4	**GR34**	**2**	**12**	**20**	**135**	**254**	**489**	**1**	**11**
			34_40	0	5	20	38	86	174	0	4
			34_41	0	2	0	35	24	66	0	3
			34_42	2	5	0	62	144	249	1	4
00:52:02	35	1 2 3 4 5 5 5	**GR35**	**15**	**26**	**6**	**73**	**37**	**215**	**18**	**29**
			35_43	12	12	3	58	23	139	6	23
			35_44	0	1	3	0	9	17	2	0
			35_45	3	13	0	15	5	59	10	6

In order to detect specific *Action patterns*, we develop a script that enables for following a particular resource chosen by a player of one group.

In Table 4, regarding the two *Action patterns*, we counted the frequencies of their occurrences and some groups are clearly following a strategy (*Choice*: GR12 and *Checked choice*: GR14, GR34) while others (GR11 and GR33) merely follow a *Checked choice* strategy, other groups are mixing the two strategies (GR13, GR15, GR35). Despite a *Choice* strategy GR12 managed to win all five levels very

fast while GR34 and GR35 didn't succeed upper to level 3 with a *Checked choice strategy*. The strategies are also sometimes very different within the same group. For instance in GR13, Player 21 has a mixed strategy *Choice* strategy (30) and *Checked choice* (17) while Player 27 has exclusively a *Choice* strategy.
A more detailed analysis could be done by comparing the number of occurrences of the patterns for each level and see the variability of the strategies along time for each player. Our tools for detecting action patterns can not calculate a pattern which can be distributed between several players of a same group and this seems to be a new perspective for evaluating *Play 2* layer.
The analysis of the digital traces enriched with the coding categories of the chat messages enables to determine whether the students are playing or not and whether they are involved in a first or second layer of play.

6. Conclusion

The preliminary results of this research confirm the diversity of the strategies followed by the different groups of players/learners, as well as those followed individually by players/learners within each group. We can detect three different types of strategies.
The first type is a "test and error strategy: the *Choice strategy*. The player/learner feed the *Tamagocours* without paying attention to the description of the resources that he/she use. Most commonly, this strategy leads to failure, but the game settings seem to be not strict enough to lead to a systematic failure. This point will be revised for the next version of the game.
A second strategy (*Checked choice* strategy) consists in feeding more carefully the *Tamagocours* by checking the characteristic of the resources before using them. These first two strategies consist in a first layer of play (*Play 1*): each player/learner performs individually according to the feedbacks provided by the game.
The third strategy consists in a collaborative play. The players/learners of a team discuss and rely on the legal copyright rules that apply to resources in order to validate the choice of one and win the game, we see here at a second layer of play (*Play 2*).
We consider this second layer of play important in achieving our educational objectives. The knowledge which is used to play is implicit in *Play 1*, while in *Play 2* it is explicitly shared during discussions between players of the same group. This explicit sharing of knowledge makes metacognition possible. In fact, the learner/player acquires the knowledge that he/she is using to play thus aware of it and able to formulate it. This is a very important point, especially in a context where few educators are available for a significant number of students which makes it difficult to organize a debriefing session, a crucial step regarding metacognition (Garris, Ahlers, & Driskell, 2002). In this respect, this work takes into account previous results obtained in a very different context but with similar educational challenges implementing a game-based learning approach (E. Sanchez, 2011).
The results of our study show the relevance of our approach in drawing a behavioral model of the students based on the identification of *Action patterns* and the coding of the chat messages. The students included in our study were involved in both layers of play described in the RM2P model. However, this first analysis does not take into account the various strategies followed by the players/learners among time. Therefore, further analysis should be run with more accurate data input. Furthermore, the variability that we observed among groups and students requires us to improve the game in order to foster the strategies which sound relevant to the educational goals (ie. *Checked choice* strategy for *Play 1* and *Play 2* as a metacognitive process). In this regard, this analytical work about the play done with *Tamagocours* will be followed by a new work dedicated to re-designing the game guided by the RM2P model: taking into account the play rather than the game, fostering the strategies based on the anticipation of the choice made for *Play 1* and fostering the collaborative play (*Play 2*) in order to facilitate the metacognition process. Therefore, we consider the RM2P model as a tool both devoted to the analysis and the design of game-based learning situations.

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