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Special issue
Perceiving and Representing
the Role of ICTs
in Learning Processes

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Do players believe they can learn through digital games?

Manuela Cantoia, Luca Milani**, Lorenzo Romeo****

Abstract

In the last two decades digital games (DG) have acquired more and more relevance in everyday life. Today the effects of the wide diffusion of digital games among laypersons represent a main field of interest in the study of education and learning in a long life perspective.

Literature provides evidences in conceiving DG as optimal learning environments, instead of being a simple leisure providing no special cognitive, emotional or social advantage. This paper focuses on the players' implicit theories on DGs, and how these theories impact on the learning process. Our main question concerns the degree of awareness of the players: do they perceive DGs as a learning opportunity? Are they aware of which soft skills they develop in their experience? Finally, are such skills perceived as transferable?

A semi-structured questionnaire, specifically designed for this study was administered to a sample of 160 participants: 70 Adults (18-30 yrs. old) and 90 Children (8-15 yrs. old).

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Results show that participants seem to be aware of the positive impact of DGs on their skills, and which ones are developed. Regardless of age, the perceived skills improvement is focused upon four main domains: visuomotor, cognitive, motivational, social skills.

Abstract (Italian)

Negli ultimi vent'anni i giochi digitali hanno guadagnato uno spazio sempre maggiore nella vita quotidiana delle persone. Questa ampia diffusione e i suoi effetti sulle persone rappresentano oggi un importante campo di ricerca sull'educazione e l'apprendimento nell'arco della vita.

In letteratura si trovano molteplici testimonianze che indicano i giochi digitali come ambienti d'apprendimento ottimali. Questo va contro la comune concezione che li rappresenta come un passatempo vuoto, che non porta a miglioramenti né in campo cognitivo, né emotivo, né sociale. Questo paper si concentra sulle teorie implicite dei giocatori rispetto ai GD, e come queste influiscono sul processo di apprendimento. La questione che viene affrontata è il livello di consapevolezza dei giocatori: percepiscono i GD come un'opportunità di apprendimento? Sono consapevoli di quali abilità sviluppano nell'esperienza di gioco? Infine, percepiscono queste abilità come trasferibili ad altri contesti?

Un questionario semi strutturato, sviluppato appositamente per questa ricerca, è stato somministrato a un campione di 160 soggetti: 70 Adulti (18-30 anni) e 90 Bambini (8-15 anni).

I risultati rivelano che i partecipanti sembrano essere consapevoli dell'effetto positivo dei GD sulle loro abilità, e quali di queste vengono sviluppate durante il gioco. Indipendentemente dall'età, la percezione di miglioramento si concentra in quattro categorie principali: visuo-motoria, cognitiva, motivazionale, competenze sociali.

In the last two decades digital games have acquired more and more relevance in everyday life (Ito *et al.*, 2008; ISFE, 2011). Today the effects of the wide diffusion of digital games (DG) among laypersons represent a main field of interest in education and learning in a life span perspective.

As far as DG are concerned, literature provides evidences in multiple directions: on the one side there is a great concern as to their violent contents and as to the large amount of time children spend using them (Swing *et al.*, 2010; Barlett *et al.*, 2009; Ferguson, 2007; Bryce & Rutter, 2006; Anderson, 2004); on the other side, there is a grow-

ing awareness about their potential in the learning processes (Gentile, 2011; Hirumi, 2010; Baek, 2010; Jackson, 2009; See 2008; Willoughby & Wood, 2008; Lieberman 2006; Efenfeldt-Nielsen 2005).

What individuals look for when they approach DG? Olson (2010) has recently provided a clear sketch of the situation: DGs are mainly meant for fun and spending time with friends. Our question is: are DG just for leisure or could they be deemed also as learning experiences? Can such different conceptions of DG coexist? If people assume that during digital game experiences they are taking a rest, they could improve many skills at different levels, but not be aware of such learning and personal development as a whole. On the contrary, if they were engaging in DG just aimed at learning, the playful experience could be softened, or even disappear, as it often happens with didactic DG.

The subjective attitude and ideas towards a particular subject, environment, device, situation or task is what we can refer to as “the implicit theory” people develop in informal ways, even before having a direct personal experience (e.g. media play an important role in turning laypersons’ idea on DG). Such theories guide individuals in their comprehension of the situation, in the choice of the aims, of the strategies to be applied, and in the sense-making of the experience (Antonietti & Colombo, 2008).

In the recent years, DG entered the classrooms with encouraging results (Tanoni, 2003; Baek 2010; Hirumi, 2010; Anolli & Mantovani, 2012; Cantoia, 2012; Felini, 2012). Nonetheless, implicit theories of both students and teachers must be considered each time such experiences are proposed to the class. Since if students and teachers approach this opportunity with too different expectations and attitudes toward the tools and their potential, the learning outcomes is compromised (Antonietti & Cantoia, 2001, 2009; Cantoia, 2009).

The effect of media in the learning process must be assessed on the basis of the learning goals one wish to achieve (Schär & Kaiser, 2006). The main question is not whether multimedia can foster learning, rather what kind of knowledge can be gained depending on the structure and the representation of the information (verbal, visual,

kinetic, reticular, linear, etc.) or the specific mental process implied (Spence & Feng, 2010; Dye *et al.*, 2009; Orsney, 2008; Green & Bavelier, 2006; Delisi & Wolford, 2002; Oyen & Bebkoo, 1996). As Antonietti and Colombo (2008) pointed out in the bi-circular bi-directional framework, the use of media is affected in a circular way by personal and social beliefs and by the criteria that everyone defines in order to assess their effects. In both cases, mental models and more or less adequate beliefs which affect approaches, intentions, expectations and strategies are put at stake. Those processes take place both in the student and teacher's mind. In order to implement a significant learning/teaching process, the single visions have to meet sharing one language, one project, common references (Cantoia, 2009).

Since we already know that many abilities are developed in the use of DGs, irrespective of assessing the single player's level of ability, we propose that the first step in a learning process in a digital environment should be to explore the implicit theories of the main actors involved in the learning setting: do players approach them with the idea they will engage in some kind of learning or do they mean it just for leisure out of school? What are adults' expectations?

To sum, there is a triple line of research to be explored:

1. The effect of DGs on the learning process: can one learn through DGs? What kinds of skills or abilities are improved? In what conditions?
2. Players and laypersons' implicit theories on DGs: are DGs an effective learning environment according to players and teachers? To what extent?
3. The coherence among individuals' conceptions and expectations and the degree of their real skill improvement: do they really improve the skills they suppose to be developing?

This paper focuses on the players' implicit theories on DGs. The third issue has to be investigated in the light of the results of this first step of studies.

Our interest lays in the 95.2 million people who everyday play with DG throughout Europe: Do players really conceive DGs as effective learning environments? As players are looking for fun, will they know

they can profit of the learning potential of DGs or will they discard it as a minor implicit effect? Do they perceive they develop soft skills in their experience? Which ones?

Our research

Materials

The questionnaire consists of 22 items regarding different fields: game habits, motivation to play, emotional background during play, self-perception regarding one's abilities and correlates of digital game play.

The questionnaire was specifically designed in order to assess the aforementioned areas and consisted of 1-4 Likert-scale like items, open questions and closed questions. It was administered in collective setting in schools and university.

Participants

A sample of 160 participants: 70 Adults (18-30 yrs. old; mean age = 22.59; DS = 2.64) and 90 Children (8-15 yrs. old; mean age = 10.81; SD = 1.38) were recruited in school and university setting by means of voluntary participation. No benefits were offered. Regarding Children participants, since the questionnaire does not include sensitive data, there was no need for a specific parental consent form. Before submitting the questionnaire to the Children, research aims and materials were submitted to schools stakeholders for approval. No gender differences were found in terms of mean age.

Data analysis

Statistics were performed with SPSS 20.0 on a PC Windows 7. Open questions were coded according to a content analysis. Data were coded by two independent judges and ambiguous cases were discussed to find an agreement.

Results

Children in the sample, compared to Adults, spend much more time with DGs (8.77 hours average a week vs. 4.42 hours) and prefer competitive game mode (Table 1).

Table 1. Age differences in DGs perception and habits

		Children Mean (SD)	Adults Mean (SD)	<i>t</i> (151)
Game mode	Hours/week	8.77 (9.39)	4.42 (6.74)	3.20**
	Collaborative	2.91 (1.03)	2.85 (0.89)	0.33
	Competitive	3.22 (0.96)	2.87 (0.91)	2.31*
	Collaborative/competitive	3.20 (0.96)	3.04 (0.87)	1.03

As first general datum, we can see that the subsample of Children compared to the Adults' one differs in different areas: aims, conceptions, emotions and in the general attitude toward DGs (Table 2).

Table 2. What's my place in DG: Adults vs. Children

Variable	Adults %	Children %	Df	Chi²
Digital gaming as pastime	10.0	30.0	1	9.41**
Proficiency in DG is a matter of training	70.0	37.8	1	16.38***
Proficiency in DG is a matter of coordination	47.1	13.3	1	22.27***
Proficiency in DG is a matter of perseverance	10.0	23.3	1	4.85*
Proficiency in DG is a matter of passion	17.1	43.3	1	12.44***
Proficiency in DG is a matter of age	2.9	14.4	1	6.22*
When you play you feel frustrated	0.0	5.6	1	4.02*
When you play you feel under pressure	22.9	7.8	1	7.27**

Note: N = 160; * = $p < .05$; ** = $p < .01$; *** = $p < .001$

Participants were asked to estimate their efficiency with DGs on a scale from 1 to 5. The mean score for Children was 4.08 (DS = 1.01) and for Adults was 2.76 (DS = 1.20). Adults' and Children's scores are significantly different at the *t* Test ($t = 7.45$; $p < .001$): children tend to perceive themselves as more competent than Adults as regards DG.

Table 3. State vs. Trait: the path to Perceived DG Expertise

Variable	B	SE (B)	β	<i>t</i>	Sig.
Hours/week	0.46	.010	.307	4.61	.000
Age	-.066	.013	-.326	-5.14	.000
Gender (M = 1; F = 2)	-.573	.169	-.225	-3.38	.001
DG Giftedness (yes = 1; no = 2)	-.664	.243	-.169	-2.73	.007

Note: $F = 32.66$; $p < .001$; $R^2 = .456$; $N = 160$

Table 4. Components of the ability with DGs

Ability area		Children				Adult			
		Mean	SD	<i>t</i> (85)	<i>p</i>	Mean	SD	<i>t</i> (68)	<i>p</i>
Training	1)	1,43	,507	-1.950	0.058	1.26	.441	-1.16	n.s.
	2)	1,67	,473	1.39	.499				
Speed	1)	1,78	,422	1.50	n.s.	1.57	.500	-0.62	n.s.
	2)	1,61	,492	1.65	.487				
Coordination	1)	1,83	,388	-0.53	n.s.	1.53	.504	0.07	n.s.
	2)	1,88	,333	1.52	.511				
Calm	1)	1,91	,288	2.16	0.033	1.85	.360	1.12	n.s.
	2)	1,69	,467	1.74	.449				
Reasoning	1)	1,52	,511	-0.97	n.s.	1.66	.479	2.14	0.038
	2)	1,64	,484	1.39	.499				
Focusing	1)	1,43	,507	-1.82	n.s.	1.66	.479	1.77	n.s.
	2)	1,66	,479	1.43	.507				
Effort continuity	1)	1,87	,344	1.32	n.s.	1.96	.204	2.34	0.022
	2)	1,73	,445	1.78	.422				
Precision	1)	1,87	,344	-0.45	n.s.	1.96	.204	1.86	n.s.
	2)	1,91	,294	1.83	.388				
Passion	1)	1,65	,487	1.12	n.s.	1.79	.414	1.30	n.s.
	2)	1,52	,504	1.91	.288				
Memory	1)	1,65	,487	-2.41	0.018	1.91	.282	1.09	n.s.
	2)	1,88	,333	1.83	.388				
Age	1)	1,91	,288	0.97	n.s.	1.96	.204	-0.09	n.s.
	2)	1,83	,380	2.00	.000				
Talent	1)	1,96	,209	1.92	0.057	2.00	.000	3.56	0.001
	2)	1,78	,417	1.78	.422				

Note: 1) under the median score; 2) above/equal the median score.

The perception of expertise is positively predicted by hours per week of DG use, and negatively predicted by age, gender, and giftedness (Table 3): both Children and Adults who self-estimate their proficiency under the median score focused on talent much more than the others. They also pointed effort continuity/training as key elements. Children under the median score signalled the role of the attitude (being calm), while Adults the importance of the mental processes involved (reasoning). Mental functions (memory) are quoted by Children above the median score (Table 4).

When asked about the skills they believed to have improved by DGs, both Children and Adults seemed to be able to distinguish specific skills, but the former were more confident in their abilities (Table 5). Important improvements have been self-reported in all areas (visuomotor, cognitive, motivational, and social). Children attributed the higher mean values to focus (3.49), effort continuity (3.35), memory (3.27), situation awareness (3.02), coordination and speed (2.96) and decision making (2.91). Adults point out insight (2.79), focus (2.70), memory (2.66) and visual imagery (2.59).

Table 5. The self-perception of the skills improved by DGs

Skill domain	Variable	Adults (SD)	Children (SD)	<i>t</i> (151)
Visuomotor	Coordination and speed	2.55 (0.78)	2.96 (0.98)	2.80**
	Visuospatial ability	2.47 (0.82)	2.87 (0.99)	2.69**
	Visual imagery	2.59 (0.76)	2.83 (0.97)	1.63
Cognitive	Decision making	2.30 (0.80)	2.91 (0.85)	4.48***
	Analogical reasoning	2.29 (0.72)	2.65 (0.94)	2.62**
	Memory	2.66 (0.84)	3.27 (0.86)	4.34***
	Insight	2.79 (0.89)	2.87 (0.88)	0.54
	Forecasting	2.58 (0.80)	2.54 (1.07)	- 0.25
Motivational	Effort continuity	2.45 (0.88)	3.35 (0.77)	6.81***
	Focus	2.70 (0.84)	3.49 (0.76)	6.12***
	Resilience to failure	2.37 (0.90)	2.67 (1.13)	1.74
Social	Perspective taking	2.07 (0.87)	2.71 (1.00)	4.15***
	Mind reading	2.16 (0.84)	2.88 (1.09)	4.50***
	Situation awareness	2.58 (0.89)	3.02 (0.81)	3.17**
	Collaborative planning	2.24 (0.96)	2.71 (1.16)	2.71**

Note: N = 160; * = $p < .05$; ** = $p < .01$; *** = $p < .001$

Self-perception of skill improvement varied also according to the self-estimation of efficacy: participants above the median score attributed to themselves a higher level of improvement in all the items (Table 6).

Table 6. The self-perception of skill improvement as a function of expertise/usage

Developed area		Mean	SD	<i>t</i> (151)	<i>p</i>
Coordination and speed	1)	2.50	.801	-3.588	.00
	2)	3.01	.942		
Decision making	1)	2.37	.832	-3.386	.00
	2)	2.84	.862		
Resilience to failure	1)	2.32	.905	-2.186	.03
	2)	2.69	1.119		
Visual imagery	1)	2.53	.837	-2.451	.02
	2)	2.88	.916		
Forecasting	1)	2.36	.829	-2.599	.01
	2)	2.75	1.019		
Effort. Continuity	1)	2.53	.837	-5.516	.00
	2)	3.29	.870		
Analogical reasoning	1)	2.14	.762	-5.011	.00
	2)	2.79	.828		
Insight	1)	2.70	.859	-1.881	n.s.
	2)	2.97	.887		
Perspective taking	1)	2.12	.930	-3.475	.00
	2)	2.66	.979		
Memory	1)	2.70	.871	-3.736	.00
	2)	3.23	.851		
Visuospatial ability	1)	2.37	.850	-3.831	.00
	2)	2.93	.936		
Mind reading	1)	2.13	.886	-4.659	.00
	2)	2.88	1.046		
Concentration	1)	2.78	.861	-4.846	.00
	2)	3.44	.794		
Situation awareness	1)	2.43	.821	-5.376	.00
	2)	3.15	.788		
Collaborative planning	1)	2.13	1.006	-3.820	.00
	2)	2.79	1.098		

Note: 1) under the median score; 2) above/equal the median score

Participants' beliefs about DGs effects were assessed through a check list of items taken from the literature. Data show that, according to our sample, DGs can improve reasoning skills (49%), the ability to react to the events (22.1%) and general cognitive skills (18.1%). Motor skills as well as personal and social ones are seldom quoted, although these subjects previously said they have developed also such skills. This datum seems to reveal that although participants feel they improve from a motor and social point of view through DGs, their idea of learning is likely focused more upon cognitive abilities (Table 7).

Table 7. The self-perception of improvements due to DGs

Variable	%
Reasoning skills	49.0
Reacting to events	22.1
General skills	18.1
Knowing oneself	5.4
Other	2.0
No learning	1.3
Motor skills	0.7
Coping (failure)	0.7
Social skills	0.7
Total	100.0

Note: $X^2(N=149)=287.530$; $df=8$ $p<.001$

When asked to say what DGs can be useful for, once more participants focused on cognitive skills: concentration (31.6%), reasoning (26.5%) and decision making (15.3%) (Table 8).

Table 8. What DGs are useful for

Variable	%
Concentration	31.6%
Reasoning	26.5%
Decision making	15.3%
Feeling competent	13.1%
Spatial orientation	7.6%
Excitement	3.6%
Other	2.2%
Total	100.0%

Conclusions

A key condition for a significant learning process to be achieved is a positive motivational attitude towards the topic and the environment displayed. When a student is presented with a multimedia interactive environment, a positive bias may be a trigger towards interpreting the learning environment as a mere playful one. Indeed, results show that students in our sample seem to be very aware of the positive impact of DGs on their skills, and are able to point out the specific domains that are improved. Regardless of age, the perceived skills improvement is focused upon two main domains: reasoning skills and reacting to events. The most quoted skills in the participants' answers are: concentration, reasoning and decision making.

The perception of expertise is positively predicted by hours per week of DG use, and negatively predicted by age, gender, and giftedness.

Regardless of age, players feel that their soft skills improve with DG experience in all the domains proposed in the questionnaire: visuo-motor, cognitive, motivational, and social skills.

Children average scores in perceived enhancement of soft skills are generally higher than Adults' ones. They also attribute higher ratings to their expertise. At this point, we can assume that DG experience has a wider and deeper impact on Children than Adults.

Adults feel more under pressure while playing and they conceive DG experience more as a matter of training and coordination. On the contrary, Children relate DG to pastime, passion and perseverance. This difference in the attitude could be influenced by the kind of game they play, but it could also speak of a different approach (gaming skills vs. emotional) to the experience. Once more the approach to the medium represents the key to understand players' attitude and beliefs: adults are mainly concerned with the strategic feature of DG, so they focus more on training to improve their own performance; on the contrary, in children the playful environment involves personal interests, so the performance is more linked to motivational and emotional factors.

Participants seem to conceive DGs as learning environments and to be sensitive to the positive impact of digital gaming on their skills.

Regardless of age the perceived skills improvement is focused upon three main domains: reasoning skills, reacting to events and general cognitive skills. Players regard DG as especially useful for improving concentration, reasoning and decision making skills.

This study collected self-reported data about the representations of DG in Children and Adults. At present these data do not let us know about players' real degree of ability, we just know that their approach to DGs is positively oriented to learning in different areas. Nonetheless, these results help in defining players' approaches to the medium, their expectations, learning goals and motivational attitude.

The questionnaire gave the opportunity to the participants to think about their experiences as players and to improve their metacognitive and meta-emotional awareness of the mental process involved in DGs. These are key elements for a correct and responsible use of DG environments in general, and particularly in education. This effort also represents the first step in the educational agreement between teachers and student in order to a) fill the gap between students' learning experiences in/out of school; b) achieve a constructive use of digital devices at school.

When teachers or educators try to shed light on their students' idea about the environment and methodologies they are to work with, they can devise the learning activities on a shared and common setting of sense and objectives, in order to better answer to their students' real education needs.

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