

## Digital games in teacher education: a game-based learning approach

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### ABSTRACT

*The present research examines student teachers' perceived learning gains from a game activity in which they were involved. During the game-activity, prospective teachers selected, evaluated and designed educational and non-educational digital games. The game-activity's goal was student teachers to i) develop skills and understanding over digital games-based learning approach and ii) engage experientially in a game-based learning environment. Students reported learning gains concerning both the content (digital games-based learning) and the method (game-based learning) of the activity they engaged in, while their learning experience was influenced by their prior conceptions and experiences with teaching, learning, technology, and games.*

### KEYWORDS

*Teacher education, game-based learning, digital games-based learning*

### RÉSUMÉ

*La présente recherche examine les gains d'apprentissage perçus des futurs enseignants à propos d'une activité de jeu à laquelle ils participaient. Pendant l'activité de jeu, les futurs enseignants ont sélectionné, évalué et conçu des jeux numériques éducatifs et non éducatifs. L'objectif de cette activité était d'amener les futurs enseignants i) à développer leurs compétences et leur compréhension d'une approche d'apprentissage basée sur le jeu et ii) à s'impliquer dans des expériences d'apprentissage basées sur le jeu. Les étudiants ont indiqué des gains d'apprentissage concernant à la fois le contenu (apprentissage basé sur le jeu numérique) et la méthode (apprentissage basé sur le jeu) de l'activité à laquelle ils se livraient, alors que leur expérience d'apprentissage a été influencée par leurs conceptions et expériences antérieures dans l'enseignement, l'apprentissage, la technologie et les jeux.*

### MOTS-CLÉS

*Formation des enseignants, apprentissage par le jeu, apprentissage par le jeu numérique*

## INTRODUCTION

Digital games constitute a rich learning environment, promoting experiential learning, problem solving, collaboration and active knowledge construction (Garris, Ahlers & Driskell, 2002; Huang, 2011; Iacovides, McAndrew, Scalon & Aczel, 2014). Although teachers are positively disposed towards using digital games in the classroom, they don't believe they have the appropriate knowledge and skills to incorporate such tools effectively in their teaching (Kearney, 2011). As a result, teachers don't utilize digital games often (Ulicsak & Williamson, 2010), and when this happens, they adopt traditional ways of teaching (Ljung-Djärf, 2008; Teo, Chai, Hung & Lee, 2008). In this light, teacher education programs in digital games, as well as research on this topic, are regarded as vital.

Literature addresses the need for teachers to understand the psychological, social and cultural perspectives of digital games, as well as their potentialities and limitations in teaching and learning (Becker, 2007; Kearney, 2011). Moreover, teachers should be able to select, evaluate and integrate digital games in the learning process (Becker, 2007; Howard, 2010; Karadag, 2015; Kearney, 2011; Ulicsak & Williamson, 2010). Research indicates that student teachers can approach digital games-based learning through activities that i) trigger reflection on the above topics, ii) familiarize them with a variety of digital games genres and iii) provide them the opportunity to design digital games and learning scenarios that incorporate digital games (Becker, 2007; Karadag, 2015).

The present study examines preschool student teachers' perceived learning gains from a game which aimed at approaching digital games in education. The reason for selecting a game as the pedagogical method within which students would approach digital games is twofold. Firstly, the game component lies in the roots of digital games. Approaching the game-based learning concept enriches the potential to understand digital games-based learning. Secondly, it is important for student teachers to experience the pedagogical methods they will employ in the future. Preschool teachers often use the game method, consequently, it was considered useful to engage them experientially in a game-based learning environment. In this context, the research studies students':

1. perceived learning gains concerning
  - the content (digital games-based learning - DGBL) of the game they were involved in
  - the applied method (game-based learning - GBL) to approach digital games
2. prior conceptions and experiences that influenced their learning experience.

## METHODOLOGICAL FRAMEWORK

Forty-six student teachers (43 female, 3 male) of the School of Early Childhood Education of Aristotle University of Thessaloniki (Greece) participated in the study. Students attended their first (74%) or second (26%) year of studies. Participants were encouraged to engage in a technologically enhanced treasure hunt game activity, lasting 15 days. The activity aimed students to a) develop skills and understanding in digital games-based learning approach and b) engage experientially in a game-based learning environment. During the activity students selected, evaluated and designed educational and non-educational digital games, through missions in digital (Facebook, QRs) and physical (School building) spaces. The learning gains of the game activity are assessed in terms of developing understanding and skills in two areas:

game-based learning (GBL) and digital games-based learning (DGBL). Four data collection tools were used:

- **Reflection paper.** By the end of the game activity, students were prompted to reflect on its learning gains. It should be remarked that students were initially informed about the main goal of the activity (approaching DGBL), in the first day of the game. The secondary goal (approaching GBL experientially) was announced after the completion of reflection papers in order to avoid predispositions in their reflections. The text of each reflection paper was screened and labeled according to the area of learning gains mentioned (GBL, DGBL, GBL & DGBL). Moreover, reflection papers were screened to identify which type of learning gain (understanding, skills) was described. A reflection paper could potentially be described with all the following labels, depending on its content: GBL understanding, GBL skills, DGBL understanding, DGBL skills.
- **Open-ended questionnaire.** The questionnaire examined students'
  - perceived learning gains from the game activity (2 questions). The answers were screened for meaning units fitting the following learning gains: GBL understanding, GBL skills, DGBL understanding, DGBL skills (content analysis),
  - perceived factors of engagement in the game (2 questions). The answers were examined in order to identify the engagement factor themes merging (thematic analysis).

During the above analysis, it was noticed that students mentioned previous experiences and conceptions influencing their learning experience. As a result, thematic analysis was conducted to examine this pattern emerging within data.

- **Self-reporting scale.** A 20-item scale was developed to measure students' perceived learning outcome. The scale was adapted to the goals and design of the present study's educational game activity (it was not constructed as a general-purpose assessment tool for teachers' digital games literacy). Participants indicated in a five-point Likert scale the degree they a) enhanced their understanding of the educational value of games and digital games, and b) developed skills to employ GBL and DGBL method (1= not at all, 2= little, 3 = some extend, 4 = much, 5 = very much). The tool had adequate internal consistency ( $\alpha = 0.747$ ) but some subscales did not exhibit an acceptable alpha (Table 1). Considering this limitation, the average of each subscale's items cannot be computed. Instead, each question will be analyzed separately. The items' answers did not follow the normal distribution and a non-parametric sign test was conducted to indicate statistical differences among the questions. The sign test can assess if the median of a collection of numbers is significantly different ( $p < 0.05$ ) or equal ( $p > 0.05$ ) to a specified value. Setting the comparison value to 5 ("very much" in Likert Scale), all questions' median differed statistically from 5 ( $p < 0.001$ ). Setting the comparison value to 4 ("much" in Likert Scale), 15/20 questions' median was statistically correlated to 4 ( $p > 0.05$ ). Four was the cutting point value that highlighted statistical differences among the questions, and for that reason, it was selected as the comparison value of the sign test.
- **Focus group.** The aim of the focus group was a deeper understanding of students' perceived learning gains and factors of engagement in the game activity. The transcribed discussions of the focus group followed the analysis conducted in the answers of the open-ended questionnaire.

**TABLE 1**

*Scale's & subscales' Cronbach's Alpha value (acceptable alpha for exploratory studies > 0.6)*

		Learning areas			
		GBL	DGBL		
<b>Learning gains</b>	Understanding enhancement	a = 0,315 (4 items)	a = 0,711 (6 items)	a = 0,688 (10 items)	a = 0,747 (20 items)
	Skills development	a = 0,737 (2 items)	a = 0,553 (8 items)	a = 0,607 (10 items)	
		a = 0,463 (6 items)	a = 0,671 (14 items)		
		a = 0,747 (20 items)			

## RESULTS AND DISCUSSION

### *Students' perceived learning gains*

Students were encouraged to report the learning gains of the activity. In the reflection papers, 55% of students did not report learning gains about DGBL approach, although they were informed that this was the expected learning gain from the activity. These students indicated learning gains stemming from the method through which they were taught: GBL approach. It could be assumed that they did not really ignore the learning gains of approaching DGBL. They chose to indicate learning gains concerning only GBL, because game is an attractive and engaging method (Garris, Ahlers & Driskell, 2002) scarcely used in teacher education, and as a result, difficult not to pay attention to. Answers in the questionnaire comply with this hypothesis. Specifically, the learning outcome's scale demonstrates that all students appeared to acknowledge both learning gains: both the GBL and the DGBL questions' mean was above 3/5 (Table 2).

As it concerns GBL, students reported less often learning gains considering the understanding of its value and more frequently gains concerning the development of relevant skills in the reflection papers (Table 3). This tendency could also be observed in the learning outcome's scale (Table 2). Specifically, the GBL skills questions exhibited a mean score equal and above the total mean score of the scale which was 3.71: students believe that their engagement in the game-activity helped them to develop skills for "*incorporating GBL in teaching*" (AVG = 3.70, item 19) and for "*designing playful learning activities*" (AVG = 4.04, item 20). On the other hand, their answers imply that the game activity did not support in the same degree their understanding in core issues of game-based learning, such as "*game can engage the player in learning*" (AVG = 3.59, item 7), "*the game does not only concern kids*" (AVG = 3.52, item 8) and "*the game does not interrupt learning*" (AVG = 3.08, item 9), These three questions were included in the six questions of the scale with the lowest mean (AVG < 3.6) and exhibited high standard deviation. The sign test revealed that the last question's (item 9) median differed scientifically from the value 4 ( $p < 0.001$ ). This question had also the lowest mean score and the higher standard deviation of the items' scale. Students' perceptions reflect deep rooted social representations that games are non-serious and concern exclusively children (Whitton, 2007) as well as the need for a systematic education in game-based learning.

**TABLE 2**

Descriptive statistics of learning outcome scale &amp; sign test results for each item

			N	Mean	Std. Deviation	Sign test p value	
UNDERSTANDING	DGBL	item 1	27	3.74	.764	.180	
		item 2	27	4.00	.679	1.000	
		item 3	27	4.00	.679	1.000	
		item 4	26	4.15	.732	.424	
		item 5	27	3.59	.694	.013	*
		item 6	27	3.44	.934	.013	*
	GBL	item 7	27	3.59	.888	.092	
		item 8	27	3.52	1.014	.077	
		item 9	26	3.08	1.055	.000	***
		item 10	27	3.70	.823	.180	
SKILLS	DGBL	item 11	27	3.63	.629	.012	*
		item 12	27	3.89	.751	.774	
		item 13	27	3.81	.681	.267	
		item 14	27	3.89	.751	1.000	
		item 15	27	3.93	.730	.791	
		item 16	26	3.65	.745	.057	
		item 17	27	3.63	.792	.057	
		item 18	27	3.19	.879	.000	***
	GBL	item 19	27	3.70	.775	.118	
		item 20	26	4.04	.720	.754	

As it concerns DGBL, learning gains were equally distributed in skills and understanding in the reflection papers (Table 3). A closer examination of these learning gains through the results of sign test (Table 2) suggests that students developed an understanding of the educational value of digital games-based learning more ( $p > 0.05$ ) in the following areas: digital games promote *preschool curriculum goals* (AVG = 4, item 2), *creative problem solving skills* (AVG = 4, item 3) and *collaborative skills* (AVG = 4.15, item 4), and less ( $p < 0.05$ ) in areas that concern digital game incorporation in other educational activities of the classroom: “*digital games can be effectively combined with other educational activities of the classroom*” (AVG = 3.59, item 5). This tendency is also observed in questions concerning the DGBL skills: students evaluated their learning gain lower ( $< 0.05$ ) in questions that concern skills of incorporating the DGBL approach in classroom “*how can I act in order to promote students’ learning while they are playing a digital game*” (AVG = 3.19, item 18), and higher ( $p > 0.05$ ) in questions concerning selecting and evaluating digital games, such as to evaluate *whether a digital game encourages experiential learning* (AVG = 3,81, item 13) and *is fun and engaging* (AVG = 3,89, item 14), and *in what way and extent does a digital game promote learning* (AVG = 3,93, item 15). The absence of preschool classroom-based missions in the game activity, in combination with the limited teaching experience of the research participants, could interpret this pattern.

**TABLE 3**  
*Students' reported learning gains in reflection papers*

		<b>N (number of students)</b>	
<b>Digital games-based learning</b>	understand the learning value	5	10
	develop skills	5	
<b>Game based learning</b>	understand the learning value	2	13
	develop skills	11	

### *Previous experiences and conceptions influencing students' learning experience*

#### *Conceptions of digital games*

Students' initial conceptions of digital games acted as a starting point for approaching digital games-based learning. Through the game they played, they elaborated their prior conceptions in different ways. Some of them recognized the learning dimensions of digital games beyond the recreational dimension they have already acknowledged (st.1 Table 4). Moreover, students redefined their ideas about the perils of digital games (st.2 Table 4), while one student described how teacher education helps in this direction (st.3 Table 4).

#### *Preschool and childhood memories*

Some students described digital games-based learning drawing from their experiences in kindergarten (st.4 Table 4) and their childhood (st.5, st.6 Table 4). Student teachers do not have learning experiences with digital games in their school life, neither with contemporary pedagogical approaches that are required to enhance learning by digital games. The connection between the previous experiences and the new perspectives student teachers encounter in their studies is crucial in teacher education (Yaman, 2016).

#### *Technology in everyday life*

One student stated that she was negatively predisposed to engage in the game because of the technological aspect of its content. Specifically, she explained that she does not use technological tools in her everyday life neither does she find interest in these tools (st.7 Table 4). Digital games seem to inevitably be endowed with attitudes student teachers have towards digital technology.

#### *Experiences and expectations from teacher education studies*

The fact that students did not have experienced game-based learning as a method in their teacher education affected their engagement in the game in two opposite directions. Some students reported engaging in the game because of the new learning environment (st.8, st.9 Table 4). Other students were disengaged with the game, because of their preference in learning methods they were more familiar with, like assignments (st.10 Table 4). Moreover, students raised issues about the suitability of games in adult education (st.11 Table 4) and reported a conflictual relationship between their role as players and as students (st.12 Table 4). These findings demonstrate a resistance to embrace game in higher education.

**TABLE 4**

*Illustrative statements of how previous experiences and conceptions influenced learning experience*

	<b>statements (st.)</b>	
conceptions of digital games	1	<i>... I had never thought of the educational goals. To analyze what more can a game offer, beyond the relaxing part (...). I had never thought so many goals like those we processed</i>
	2	<i>... we thought that... let's say children get addicted to games, or games include violence, convey wrong messages, but there are games that can really help</i>
	3	<i>Now that we read about and analyze games, we understand it helps the learning process. But our parents could say that children must not engage in the computer because they are too young and the consequences for their life afterwards will be bad. Someone who doesn't know, can't understand that children can learn through games</i>
preschool & childhood memories	4	<i>I didn't have in mind that children in preschool play digital games. Because we didn't play digital games and I thought that this would be the case in preschool when we will graduate and become preschool teachers</i>
	5	<i>I had in mind very old games like play station, game boy...</i>
	6	<i>I have now realized that digital games have evolved in such a degree, that completely contribute to the learning processes</i>
technology in everyday life	7	<i>I'm acquainted with motion games because I played relevant games in school. But I'm not particularly acquainted with digital games, and generally, I don't have a particular interest in digital technology (...) I use technology basically for assignments, for nothing else</i>
experiences & expectations from teacher education studies	8	<i>[I was engaged by the fact that] it was the first time in my studies I had the chance to play a game in a lesson</i>
	9	<i>That's exactly why I liked it so much: it was something different that we had never done in other lessons</i>
	10	<i>The treasure hunt game, in which we searched for rectangles [QRs], it seemed to me more childish, not for my age</i>
	11	<i>We had to become kids again in order to accomplish a task in which we are higher education students</i>
	12	<i>I would rather do an assignment which is, I believe, for our age, and we are familiar with due to previous assignments</i>

## CONCLUSION

Students seemed to develop skills for selecting, evaluating and incorporating digital games in educational design, as well as to understand the educational value of digital games. These learning gain traces are consistent with the goals of teacher education in digital games (Becker, 2007; Karadag, 2015). At the same time, experiencing a game-based learning approach in their studies, led to the development of skills to design playful activities, but did not lead itself to a full understanding of the learning value of games. Deep rooted conceptions like “games concern children” or “games interrupt learning” insisted. Moreover, students’ personal conceptions and experiences acted as a lens through which students approached the digital game. Students’ prior

representations either triggered reflection on the learning potential of digital games or impeded their learning process, because of a negative attitude towards digital technology. Research findings, although are not to be generalized due to small sample size and the exploratory research tools, indicate tendencies that stress the importance of enriching the goals of teacher education in digital games, including goals of elicitation and processing student teachers' conceptions on technology, game, and learning.

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