Computers & Education 123 (2018) 195–211

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

The Creativity Challenge Game: An educational intervention for creativity enhancement with the integration of Information and Communication Technologies (ICTs)

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ARTICLE INFO

Keywords:
Computer-mediated communication
Cooperative/collaborative learning
Interactive learning environments
Learning communities
Teaching/learning strategies

ABSTRACT

Creativity enhancement is an educational objective. The integration of Information and Communication Technologies (ICTs) into the curriculum is another goal of many educators. In this study a creativity enhancement intervention was conducted with participants students (N = 90, 46 male, 44 female) of mean age M = 18.38, in an information systems course. A quasi-experimental design was employed and the proposed method included the extensive use of Facebook, a collaborative team structure, a game-like competitive environment, questions generation and answering. Creativity was measured with several pre-post divergent thinking tests. Academic achievement was obtained through exam results. Additional data were collected with online questionnaires. Results show that the intervention was overall effective in stimulating creativity. There was a statistically significant increase in fluency, flexibility, elaboration and originality, as measured by divergent thinking tests. Total student creativity calculated with the use of principal component analysis showed a significant positive link to academic achievement and ICT knowledge. Students with almost zero Facebook usage exhibited the highest levels of creativity followed closely by their peers with the highest Facebook usage. Creativity enhancement was not related to Facebook usage or ICT knowledge. Results and implications are discussed, and propositions for future research are offered.

1. Introduction

Today, in this rapidly changing world, characterized by unpredictability, globalization and instability, creativity evolved from being a competitive differentiator to a necessity for survival (Csikszentmihalyi & Sawyer, 2014; Wagner & Hollenbeck, 2014). Acknowledging the importance of creativity, researchers and teachers have proposed several theories and methods as to how to develop it (Collard & Looney, 2014; Fasko, 2001; Shaheen, 2010). Although many of these methods were tested mainly on children and adolescents, because of the old supposition that the ability to create something original declines with age (Lehman, 1953), in recent years empirical studies and meta-analyses suggested that creativity as a dynamic life-long process of self-expression can be enhanced in any age (Stine-Morrow et al., 2014; Tsai, 2013). Thus, in this reality, creativity enhancement in higher education is a major individual, organizational and societal challenge.

Another aspect of our modern world is the emergence, development and prevalence of ICTs (Bilbao-Osorio, Dutta, & Lanvin, 2014), leading to the Internet of Everything where ICTs can be used for the creation of new capabilities (Cisco, 2013) changing the nature of innovation in various ways (Baller, Dutta, & Lanvin, 2016). Today renowned researchers, educators and policy makers came

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https://doi.org/10.1016/j.compedu.2018.05.009
Received 16 July 2017; Received in revised form 13 May 2018; Accepted 14 May 2018
Available online 15 May 2018

Table 1
Some recent studies on creativity enhancement.

(Study) Researcher, year.	Age (years)	Measures-Assessment tools and techniques	Intervention – method and tools.	Creative variables increased
Alfonso-Benl., Meléndez, García-Ballesteros, 2013	5–6	Test de Creatividad Infantil (TCI), Battelle Developmental Inventory	Games (drawing, explore through senses, dance, etc.)	Total creativity.
Maker, Jo, & Muammar, 2008	K to 6th grade	Test of Creative Thinking – Drawing Production TCT-DP	A curriculum with emphasis on problem solving	Total creativity
Garaigordobil & Berrueco, 2011	5–6	Torrance Test of Creative Thinking, Behaviors and Traits of Creative Personality Scale	Play sessions	Verbal: fluency, flexibility, elaboration, Graphic: fluency, elaboration, originality
Aqda et al., 2011	Junior 1st grade	Torrance Test of Creative Thinking (TTCT)	Computers aided instruction	Originality, elaboration
Hoffmann & Russ, 2016	5–8	Alternate Uses Task-Wallach & Kogan	Pretend play	Fluency, originality
Chang, 2013	Children 4th grade	Technological Creativity Test, Creative product Scale, Williams Creative Thinking Test	Online problem solving	Product elaboration (no changes in divergent thinking)
Garaigordobil, 2006	10–11	Torrance Test of Creative Thinking, Assessment of the creative product	Play, various games and cooperation	Verbal: originality Figural: originality, resistance to premature closure, elaboration
Hsiao et al., 2014	11–12	Creativity Assessment Packet (CAP)	Digital Game Based Learning System	Total creativity and manual skills
Rashid & Rahman, 2014	19	Thinking Creatively in Action and Movement	Online mentoring activity via Facebook	Fluency
Robbins & Kegley, 2010	19.76	Torrance Test of Creative Thinking (TTCT)	Online creative thinking program	Total creativity and self efficacy
Karwowski & Soszynski, 2008	M = 22	Test of Creative Thinking-Drawing Test of Creative Imagination	Role play games	Fluency, originality
Hutton & Sundar, 2010	M = 22	Abbreviated Torrance Test for Adults (ATTA)	Video Games playing	Fluency and overall creativity index
Yeh, 2015	25	Idea generation task	Action-video games playing	Originality, flexibility elaboration
Benedek et al., 2006	31.39	Verbal Creativity Test (VKT)	Computer-based creativity training (verbal + functional)	Ideational Fluency

to the unanimous agreement that to have a sustainable innovative society, new technologies, education and creativity training have to be linked and integrated in effective educational and training systems (Cachia & Ferrari, 2010; Means, Toyama, Murphy, Bakia, & Jones, 2009; Schmid et al., 2014; Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011).

In an attempt to answer this contemporary demand of our society many researchers have developed and tested creativity enhancement programs and a small sample is shown in Table 1. Although many of the previously tested educational interventions were successful there remains the need for more work in this area and for the development of more practical approaches that would be simple, effective, flexible and easily reproduced even in today's uncertain and tough economic times. This paper presents a creativity enhancement intervention that was developed based on findings of previous studies, and tested successfully in an European university. The present work adds to existing literature by elaborating further on the concepts of creativity enhancement, academic achievement and ICT inclusion into education. Also, this study has practical implications by offering a sufficient, uncomplicated, inexpensive and easy to replicate creativity enhancement training, that educators and researchers can advantageously exploit and develop further.

2. Literature review and theoretical framework of this study

2.1. Creativity-thinking processes and knowledge

Creativity is multiple (Sternberg, 2005) and difficult to define. One definition of creativity is "*The cognitive processes that lead to the production of new, original ideas, processes, or artifacts that are judged to be useful or otherwise of some value.*" (Houtz & Patricola, 1999, p. 1). Pioneers of the field, like Guilford and Torrance, suggested that creativity is a multifaceted phenomenon and someone can be very creative in one domain, while showing no creativity in all other domains. As a multifaceted phenomenon creativity requires a multitude of mental processes combining both convergent and divergent thinking (A. Cropley, 2006). Convergent thinking assumes that every problem has only one single correct solution and employs logic, knowledge and familiar verified techniques to find it (A. Cropley, 2006; Kim & Pierce, 2013a), while divergent thinking, the *potential* to be creative, is the ability to see relationships among things in unconventional ways and to produce multiple original ideas (Runco & Acar, 2012). It is believed today that we can enhance creativity by developing divergent thinking, but for creativity to happen convergent thinking is needed, to evaluate, select and deliver the complete creative products (Kim & Pierce, 2013a; Sternberg, 2006). The 'threshold theory' assumes that high levels of creativity require a certain above-average level of IQ, suggesting a strong relationship between knowledge, 'traditional' intelligence and creativity (Jauk, Benedek, Dunst, & Neubauer, 2013; Jung et al., 2009). Also, several studies and meta-analysis provide evidence of a positive and constant across time correlation between creativity and academic achievement (Ai, 1999; Kim, 2008).

2.2. Creativity, education and methods of enhancement

The Componential Theory of Creativity presumes that all humans are able to be creative in some domain and the environment can influence this behavior (Amabile, 1997). Also, according to Bloom's Taxonomy of Learning Domains or Behaviours creativity belongs to the higher order cognitive processes and can be taught and developed (Anderson, 2005; Ben-Zvi & Carton, 2014). Indicators of scientific creativity, executive functions like attention span, concentration and perseverance can be detected, measured and enhanced (Diamond & Lee, 2011) and several meta-analyses suggest that creativity training programs are generally effective (Scott, Leritz, & Mumford, 2004; Tsai, 2013).

In regard to creativity enhancement researchers suggest to engage the students in the educational process, to involve them in more active roles and make them feel "*partners of the teacher*" (Mann, 2015). Also, to stimulate their curiosity, and encourage creative exploration, sensible risk taking, testing and demonstrating their creativity (Blašková, 2014; Houtz & Patricola, 1999). Table 1 provides a small sample of creativity enhancement programs used by other researchers, basic design and tools used and their results.

2.2.1. Creativity and play

According to the literature a game-like atmosphere in which students would be free to participate, form groups, collaborate, play with ideas and compete, without the fear of penalties or punishment, will promote creativity and learning (Fasko, 2001; West, Hoff, & Carlsson, 2016). Previous studies suggest that educational games designed or just tailored by teachers have the potential to enhance learning outcomes (Kao, Chiang, & Sun, 2017) and as can be seen in Table 1, many researchers used play and games for creativity enhancement with positive results. Also, literature provides evidence that play enhances creativity regardless of the form of the game played and the age of the participant: Creativity is enhanced in children participating in recreational activities (Garaigordobil, 2006; Hoffmann & Russ, 2012), in adolescents playing videogames (Jackson et al., 2012) and even in adults at workplace (West et al., 2016).

2.2.2. Rewards

Amabile stresses the fact that educators aiming to stimulate their students' creativity should be careful because extrinsic motivation and the perception of the task engagement as a duty can inhibit creativity (Amabile, 1985). However, when people are intrinsically motivated by their own interest, enjoyment, and challenge, there is not any diminishment in their creativity and they usually exhibit greater creativity (Amabile, 1985, 1997). Therefore, it is advisable to use bonuses or prizes that reward the creative process itself and the willingness to explore, discover and innovate, and not the final creative product (Erbas & Bas, 2015).

2.2.3. Information and Communication Technologies (ICTs)

This generation, Generation Z, is born into the era of information technology and social media, smartphones, tablets and mobility, and uses them for everything: from getting information to staying in touch with family and friends (Hall, 2016). To promote active learning teachers should embrace the habits and practices of their digitally savvy students and ICT provides all the tools to achieve it. Researchers acknowledge that ICT today is not just the mere vehicle to deliver instruction but when more modern applications are employed technology affects profoundly the learning process and achievement (Schmid et al., 2014) and several studies and meta-analyses suggest that there is a strong positive connection between information technology, student engagement and beneficial learning outcomes (Chen, Lambert, & Guidry, 2010; Kuh & Hu, 2001; Liao, 2007; Means et al., 2009; Merchant, Goetz, Cifuentes, Keeney-Kennicutt, & Davis, 2014). In respect to creativity Table 1 shows that many researchers examined the use of ICTs in creativity enhancement programs with positive results (Aqda, Hamidi, & Rahimi, 2011; Benedek, Fink, & Neubauer, 2006; Chang, 2013; Hsiao, Chang, Lin, & Hu, 2014; Hutton & Sundar, 2010; Rashid & Rahman, 2014; Robbins & Kegley, 2010; C. S.-H.; Yeh, 2015) and plenty of studies support the notion that e-learning, online knowledge sharing and interactivity improve students' creativity (Ardaiz-Villanueva, Nicuesa-Chacón, Brene-Artazcoz, Sanz de Acedo Lizarraga, & Sanz de Acedo Baquedano, 2011; Jang, 2009; Wei, Peng, & Chou, 2015; Y.; Yeh, Yeh, & Chen, 2012). The meta-analysis of DeRosa, Smith and Hantula examining the influence of ICT on the creative productivity of idea-generation groups found that "*The medium matters*" and there are quantity and quality benefits when the creative process of idea generation takes place in electronic environments (DeRosa, Smith, & Hantula, 2007). Hence, integration of ICT is a prerequisite for the success of any creativity enhancement intervention.

2.2.3.1. Facebook, creativity and academic performance. Nowadays, several surveys and studies show that students outside classroom use as major learning resources cell phones, Facebook and YouTube (Petrovic, Jeremic, Cirovic, Radojicic, & Milenkovic, 2014; Ractham & Firpo, 2011, pp. 1–10; Thomas & Brown, 2011; Towner & Muñoz, 2011). Up to 90% of undergraduates use Social Networking Services or Sites (SNS) like Facebook on a daily basis for communication, recreation, information, and to support their learning, they are accustomed with these media and the various collaboration apps they provide (Fewkes & McCabe, 2012; Meishar-Tal, Kurtz, & Pieterse, 2012; Petrovic et al., 2014; Wang, Woo, Quek, Yang, & Liu, 2012). Educators that want to enhance creative learning should create a space where their students would share knowledge and information, cooperate with others and become engaged in a truly creative process (Eid & Al-Jabri, 2016; Yang & Cheng, 2010). Although Facebook was not developed for learning purposes, students perceive it as more informal and user-friendly in comparison to learning management systems (LMS) (Deng & Tavares, 2013; Rashid & Rahman, 2014) and they tend to use it in their everyday life, therefore, teachers can take advantage of this fact and use Facebook as an effective tool to promote active learning, collaboration and academic networking (Aaen & Dalsgaard, 2016; Arteaga Sánchez, Cortijo, & Javed, 2014; Hasan, 2013; McCarthy, 2012). Moreover, previous research shows that Facebook Groups in particular offer a unique type of engagement, the process in a closed group is inherently intimate, interactive and decidedly collaborative, dialogue is a prerequisite and the synergy and mutual reinforcement can make the whole activity extremely creative (Ivala & Gachago, 2012; Meishar-Tal et al., 2012; Miron & Ravid, 2015; Wang et al., 2012).

In concern to educational outcomes, much research in recent years has focused on the relationship between Facebook usage and academic performance and the results are mixed with some researchers suggesting a positive link (Ainin, Naqshbandi, Moghavvemi, & Jaafar, 2015), several reporting a negative link (Junco, 2012; Kirschner & Karpinski, 2010; Rouis, Limayem, & Salehi-Sangari, 2011) and others showing that there is almost no link (Huang, 2018; Kabre & Brown, 2011; Pasek, More, & Hargittai, 2009; Wise, Skues, & Williams, 2011). As for the link between student creativity and Facebook, we found very few studies examining this particular subject (Alias, Siraj, Daud, & Hussin, 2013; Rashid & Rahman, 2014) and obviously more work is needed.

2.2.4. Problem solving and question generation

Problem Solving is accepted as an efficient way to develop creativity, especially when we have the so called open-ended-problems, assignments and case studies, that require individuals to engage their higher cognitive abilities like analysis, synthesis, and restructuring of the problem, thus stimulating creative thinking (Mumford, Medeiros, & Partlow, 2012). But what about the problem itself? As Albert Einstein put it: "*The formulation of a problem is often more essential than its solution*" and "*To raise new questions, new possibilities, to regard old problems from a new angle requires creative imagination and marks real advances in science*" (Einstein & Infeld, 1967). Also, according to Paul Souriau there is something mechanical in finding solutions, while the truly creative mind can discover problems (Souriau, 1882). Asking questions and finding problems is part of the critical and creative thinking process, hence, it is an efficient way to develop creativity (Ennis, 2011; Reiter-Palmon & Robinson, 2009). There are numerous studies and meta-analyses investigating the effect of problem based learning and student question generation, on knowledge elaboration and learning, and most of these studies provide evidence that student question generation is an effective way of actively engaging the students in the learning process, leading to very positive learning results (Furtak, Seidel, Iverson, & Briggs, 2012; Luxton-Reilly & Denny, 2010; Schmidt, Rotgans, & Yew, 2011).

Based on the above literature we decided to use play, rewards, various ICT tools, Facebook and both problem solving and student question generation in the design of our creativity enhancement intervention.

2.3. Study objectives and hypotheses

The objectives of the present study are:

1. To design an educational intervention with ICT integration that will stimulate students' creativity and administer it for a sufficient

time, so as to bring its cognitive effects.
2. To examine if students will respond to the intervention differently based on their individual habits and characteristics (academic achievement, computer knowledge, Facebook usage etc).
3. To find if there are any correlations between student creativity, academic achievement, ICT knowledge and Facebook usage.
4. To evaluate the overall effects of the creativity enhancement intervention on students' creativity and draw useful conclusions.

Concerning creativity and creativity enhancement our hypotheses are:

Hypothesis 1. After the intervention students will perform better in creativity tests.

Hypothesis 2. Academic achievement and creativity of students will be positively linked.

Hypothesis 3. Students with higher ICT knowledge and use will be more creative.

Hypothesis 4. Creativity of students with higher ICT knowledge and use will be more enhanced after the intervention compared to their classmates.

Hypothesis 5. Creativity of students and time spent on Facebook in their everyday life will be positively correlated.

Hypothesis 6. Creativity of students with higher Facebook use will be more enhanced after the intervention when compared to their peers.

3. Method

3.1. Participants

Subjects were 90 undergraduate students (46 male, 44 female) enrolled in an Information Systems undergraduate course at an European University. Students' age ranged from 17 to 21 ($M = 18.38$, $SD = 0.65$) and all of them had no previous experience of an educational intervention of this kind. They completed several tests and questionnaires and were ensured that their responses would be strictly confidential. Students volunteered for the study after being told that it was an intervention aiming to stimulate their creativity and that they would receive an extra credit for their participation in the form of bonus points.

3.2. Design and procedure

3.2.1. The game and the Facebook Group

Based on the aforementioned literature suggesting that challenging games with rewards stimulate creativity, we designed an educational intervention with a cooperative reward structure and in the form of a game called "Creativity Challenge". We included the word *challenge* to emphasize the competitiveness of the game because research shows that healthy competition stimulates dedication, hard work and creativity (C.-H. Chen & Chiu, 2016; Wu, Wu, Chen, & Chen, 2014). The game was played mainly online inside a Facebook Group, called CreativIS (Creativity + Information Systems), making it extremely convenient to students to follow the procedure using their tablets and smartphones. The Facebook group was closed to the public to protect the privacy of the game and to give the feeling of exclusivity and security to participants, thus enhancing collaboration and creative teamwork (Aaen & Dalsgaard, 2016). The Wall of the Facebook group was used to post the rules of the game, make regular announcements about the procedure, upload several files with relevant content and to answer in detail all the questions of the students.

3.2.2. The procedure

Fig. 1 shows the experimental procedure.

First Day. On the first day of the intervention, a presentation of the game was held in class, using multimedia, where the its rules of the game were explained thoroughly and written material with first instructions was delivered. Also, a short "*motivation note*" distributed to the students, informed them that they would receive a bonus for their participation and that the goal of this intervention was to support their learning, enhance their creativity and equip them better for their future professional and everyday life.

First Two Weeks. After the presentation of the game, the students had a period of two weeks to decide if they were going to participate, to form teams, choose a leader and find a name for their team. To find a name for their team was requested by researchers to boost the game-like atmosphere and also to facilitate the formation of team identity with all the beneficial consequences like, enthusiasm, bonding, collaboration and several other positive effects, eventually leading to better creative and educational results (Haslam, Powell, & Turner, 2000). The researchers did not interfere in any way in the formation of the teams. Teams had to consist of three members (for exceptional reasons four members were allowed). Finally, 28 teams (90 participants) participated in the game. By the end of the introductory period, the leader of each team sent an e-mail to the administrator of the game – one of the researchers, announcing the formation of his/her team and their willingness to join the game. The team was accepted and all members were invited to join the Facebook group.

Pre-Tests. Before the beginning of the intervention students were tested for creativity with paper and pencil Divergent Thinking Tests, where they were instructed to give many original answers, because previous research suggests that when participants are specifically instructed to produce many original answers they respond accordingly and divergent thinking scores tend to increase

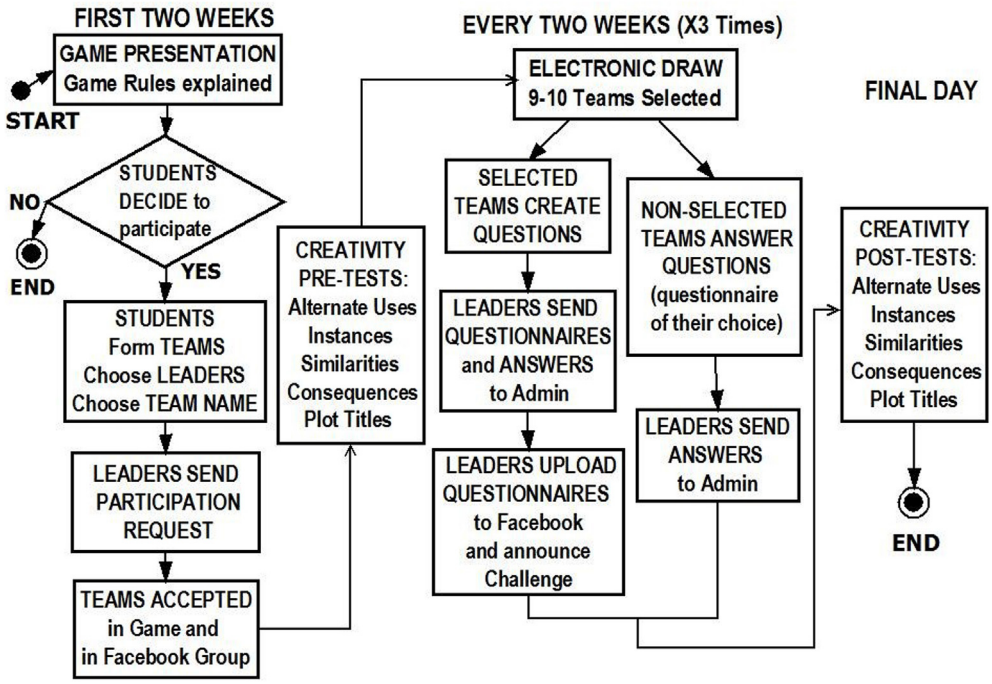

Fig. 1. Procedure of the educational intervention.

(Nusbaum, Silvia, & Beaty, 2014). After the pre-tests the first electronic draw was conducted and nine (9) teams were randomly selected.

During the procedure. According to the game, every two weeks, an electronic draw was held, and a number of teams (9 or 10) were selected. The names of the selected teams were announced and appeared on the Facebook Group Wall with full description of their project assignment. The selected teams, within two weeks, had to prepare a set of essay questions with their answers based on the theory and educational material taught by the professor during the past two weeks prior to the electronic draw. Essay questions (and their answers) were chosen to be their project assignment due to their open structure that stimulates the higher levels of cognition, critical thinking and creativity (Cropley & Urban, 2000; Husain, Bais, Hussain, & Samad, 2012). Teams were allowed to use freely books, notes and any other material they considered necessary to complete their task. Students were also prompted to take advantage of the various Facebook apps, online search machines, files storage, synchronization, video, voice and instant messaging services, and other tools of ICT, to stimulate their knowledge accumulation, collaboration, and creative work. Also, useful educational material, was supplied through the 'files' section in Facebook and Google Drive. The leaders of the teams, upon the completion of their assignment, sent an email to the administrator with the essay questions and their answers, and on the same day posted on the Wall of the Facebook Group only the questionnaire, announcing the *challenge* to other teams.

The first cycle of the game was followed by another electronic draw and again some teams were selected to create their questions within two weeks. During these two weeks the rest of the teams, were free to choose one of the uploaded set of questions, answer them in the most creative and elaborative way they could, and send their answers to the administrator of the game. The whole intervention lasted one semester. The procedure and the electronic draw were controlled so that by the end of the game all the teams had completed equal number of projects (three projects). The main project consisted of 5–6 essay questions with their answers and the two smaller projects included only the answers to the questions of other teams. It was emphasized that groups with the most creative questions (as voted by their co-students) will receive an extra bonus. During the last month students had to log into their student account to complete a set of questionnaires (demographic, 40-item, evaluation) and vote for 'Best teams' questionnaires". Researchers used identification numbers to match responses.

Post-Tests. On the last day of the procedure students were tested again with paper and pencil Divergent Thinking tests.

3.3. Tools and measures

3.3.1. Divergent thinking tests (DT)

Due to the inherent complexity of creativity a reliable and valid assessment should be based on several and different creativity tests. The most widely used are the Divergent Thinking (DT) Tests (Kim & Pierce, 2013b). However, these tests, like any human construction, are not perfect and their results are influenced by many factors, suggesting that they are merely helpful estimates of the creative *potential* (Runco & Acar, 2012). In our study we used Guilford's Tests: Alternate Uses (Benedek, Mühlmann, Jauk, & Neubauer, 2013; Christensen, Guilford, Merrifield, & Wilson, 1960), Consequences (Christensen, Guilford, & Wilson, 1957), and Plot

Table 2
Divergent thinking tests.

Test	Time (min)	Instruction	Objects used (1.pre-test 2.post-test)
Alternative Uses	3	For the given object - Think of as many uses as you can and list them down.	1. a towel, a brick 2. a newspaper, a rope
Instances	4	List as many items as you can think of, that contain this specific component.	1. wheel 2. button
Similarities	3	Write down analogies, similarities, commonalities between these objects.	1. orange-apricot 2. airplane- bus
Consequences	5	Think of as many results or consequences as you can of the following hypothetical situation and write them down.	1.What would happen if all people suddenly lose their hearing ability? 2.What would happen if man does not have any need for food?
Plot Titles	6	For the given short story write as many appropriate titles as you can think of.	

Titles (Berger & Guilford, 1969; Christensen et al., 1957)) and the Wallach-Kogan's Tests: Instances and Similarities (Wallach & Kogan, 1965), but with a time limit. Table 2 shows the tests that we used and times for administration.

We chose these Divergent Thinking tests because of their high reliability and validity (Cropley & Maslany, 1969; Cropley, 2000) as well for practical considerations including simplicity of implementation, low-cost, testing time, and uncomplicated scoring procedures. All tests were scored for the four dimensions of creativity or 'production factors of divergent thinking': fluency, flexibility, elaboration, originality (Guilford & Hoepfner, 1966; Guilford, 1956; Runco & Acar, 2012). *Fluency* is the total number of responses, therefore, we counted the responses and one point was given for each response. *Flexibility* is the degree of difference of the responses, that is the number of categories or domains that the answers cover; one point was given for each category. *Elaboration* is the level of detail of the response; scoring: one point for an elaborated response and two points for very elaborated responses. *Originality* is the statistical infrequence of each response, each response was compared to the total amount of responses from all the participants; responses that were given by only 5% of the students were unusual and were given 5 points, responses given by only 1% were considered unique and scored 10 points ("Guilford Uses Task," 2016; Lemons, 2011). The internal consistency of the tests was good with Cronbach's Alpha for fluency $\alpha = 0.94$, flexibility $\alpha = 0.91$, elaboration $\alpha = 0.82$, originality $\alpha = 0.77$. Reliability of tests for pre-test and post-test was also good with $r(79) = 0.87$, $p < .001$ for fluency, $r(79) = 0.77$, $p < .001$ for flexibility, $r(79) = 0.70$, $p < .001$ for elaboration, and $r(79) = .72$, $p < .001$ for originality. The DT Tests administered to students were scored independently by two raters. The two-way random absolute agreement method of obtaining Intraclass Correlation Coefficients was used to examine inter-rater reliability (Bartko, 1966; Landers, 2015; Shrout & Fleiss, 1979) and was found to be excellent (Cicchetti, 1994): with ICC = 0.983 (95% CI, 0.973 to 0.989) for fluency, ICC = 0.903 (95% CI, 0.550 to 0.938) for flexibility, ICC = 0.804 (95% CI, 0.447 to 0.909) for elaboration, and ICC = 0.950 (95% CI, 0.922 to 0.968) for originality. For the purpose of the study the creativity measures of the two raters were added together to form a composite measure. Because of absences, creativity scores are unavailable for 9 students; thus, from the 90 original participants 81 participated in the DT Tests of Creativity.

3.3.2. Questionnaires

All questionnaires (demographic, 40-item, evaluation) were delivered online with the help of Google Forms. Participants were assured of the confidentiality of their responses. An identification number was used to match responses to students. Each student had to sign into his/her student account to complete each questionnaire and send it, without the option of revision and resubmission or future changes by anyone.

3.3.2.1. ICT knowledge and use. ICT knowledge and use of students was estimated based on students self-evaluation. According to their answers to questionnaires, students were assigned to four Computer Knowledge groups (CKN). Group 1 was called 'basic' and included students that had very basic knowledge ICT and used a computer or a tablet rarely, group 2 = 'average', group 3 = 'good', and group 4 = 'expert' with students that perceived themselves as 'experts' with extremely high knowledge and use of ICTs.

3.3.2.2. Facebook time and usage. Students were asked to estimate their average time spent daily on Facebook (FBTime) and their answers were converted to minutes. Students were also asked about their Facebook usage habits and based on their answers they were separated to four 'Facebook use' groups (FB). Group FB1 – consisted of students that didn't use Facebook at all, and created a Facebook profile just to participate in the game, and students that had a profile but checked it once in a month or in two weeks. Group FB2 – students that used Facebook almost daily but less than 60 min, group FB3 - students that used Facebook everyday for 1–3 h and FB4 with students that through their smartphones were continuously connected to Facebook and were active on it for several hours daily.

3.3.3. Academic achievement

At the end of the semester students took paper and pencil final exams (multiple choice) and the results of these exams (Points) were used as a measure of their academic achievement. Two of the 81 students that participated in the Divergent Thinking (DT) Tests did not participate in the final exams, therefore, in our analysis regarding academic achievement we used the exam results of 79 subjects.

Table 3
Descriptive Statistics DT tests scores.

	N	Min.	Max.	M	SD
F1	81	16.00	77.00	48.94	12.33
FL1	81	10.00	72.00	39.11	11.43
EL1	81	1.00	7.00	3.20	1.27
O1	81	.00	20.00	5.31	5.50
F2	81	21.00	103.00	60.90	16.78
FL2	81	13.00	94.00	45.96	12.79
EL2	81	1.00	8.00	3.83	1.53
O2	81	.00	25.00	9.94	5.56

Pre tests: F1 = fluency, FL1 = flexibility, EL1 = elaboration, O1 = originality.
Post tests: F2 = fluency, FL2 = flexibility, EL2 = elaboration, O2 = originality.

4. Results

4.1. Descriptive statistics

Descriptive statistics, means and standard deviations for pre-tests and post-tests components of creativity can be seen in Table 3. As can be seen in Table 3 fluency is the dimension of creativity which has the highest maximum value both in pre-tests and post-tests, followed by flexibility, originality and elaboration.

4.2. Creativity enhancement

To assess the effects of the educational intervention we conducted a repeated measures ANOVA, with Time as within-subjects factor with two levels (level 1 = pre-test, level 2 = post-test) and dependent variables the four components of creativity (fluency, flexibility, elaboration, originality). Table 4 shows that there was a significant linear increase between pre-tests and post-tests for all four components of creativity, for fluency $F(1,80) = 151.26$, $p < .001$, $\eta^2 = 0.65$, flexibility $F(1,80) = 54.32$, $p < .001$, $\eta^2 = 0.40$, elaboration $F(1,80) = 24.97$, $p < .001$, $\eta^2 = 0.24$, and originality $F(1,80) = 100.00$, $p < .001$, $\eta^2 = 0.56$.

Follow-up paired samples t-tests presented in Table 5, demonstrate that there was a significant increase in the post-test scores when compared with pre-test scores for all four dimensions of creativity. Students' fluency before the intervention F1 ($M = 48.94$, $SD = 12.33$) was significantly lower than fluency after the intervention F2 ($M = 60.90$, $SD = 16.78$), $t(80) = -12.30$, $p < .001$, Cohen's $d = 1.37$. Originality was also significantly higher after the intervention O2 ($M = 9.94$, $SD = 5.56$) compared to originality before the intervention O1 ($M = 5.31$, $SD = 5.00$), $t(80) = -10.00$, $p < .001$, $d = 1.11$. Table 5 shows that the other two creativity dimensions were also higher after the procedure, although elaboration appears to be less affected by the intervention: elaboration before EL1 ($M = 3.20$, $SD = 1.27$), elaboration after EL2 ($M = 3.83$, $SD = 1.53$), $t(80) = -5.00$, $p < .001$, $d = 0.56$. The above results indicate that the educational intervention functioned as intended and students performed better in creativity tests after the intervention. Thus, Hypothesis 1 is supported.

4.3. Creativity, academic achievement and facebook usage

To compute a total creativity score for each student we used Principal Component Analysis (PCA). On the basis of Eigenvalue > 1 and a Scree Plot test we extracted only one factor. The overall results of the divergent thinking creativity tests loaded positively on this factor with fluency = 0.907, flexibility = 0.928, originality = 0.641, elaboration = 0.623, with Eigenvalue of 2.47 which accounted for a total of 61.75% of the variance. Factor scores were computed via regression. With the use of PCA we calculated the 'TCreativity' = Total Creativity of students. Bivariate Pearson's correlation coefficients revealed a significant positive link between the Total Creativity of students (TCreativity) and their academic achievement (points), $r(77) = 0.50$, $p < .001$, therefore,

Table 4
One way within-Subjects ANOVA.

Source	Measure	*SS*	*df*	*MS*	*F*	Sig.(2-tailed)	η^2
Time	Fluency	5796.06	1	5796.06	151.262	.000	.654
	Flexibility	1901.39	1	1901.39	54.323	.000	.404
	Elaboration	16.06	1	16.06	24.968	.000	.238
	Originality	868.06	1	868.06	100.000	.000	.556
Error(Time)	Fluency	3065.44	80	38.32			
	Flexibility	2800.11	80	35.00			
	Elaboration	51.44	80	.64			
	Originality	694.44	80	8.68			

Table 5
Results of Paired Samples *t*-test.

Pairs	Paired Differences					*d*	*t*	*df*	*Sig. (2-tailed)*
	Mean	*SD*	*SE Mean*	*95% CI*					
				Lower	Upper				
F1 - F2	−11.96	8.75	.97	−13.89	−10.02	1.37	−12.30	80	.000
FL1 - FL2	−6.85	8.37	.93	−8.70	−5.00	0.82	−7.37	80	.000
EL1 - EL2	-.63	1.13	.13	-.88	-.37	0.56	−5.00	80	.000
O1 - O2	−4.63	4.17	.46	−5.55	−3.71	1.11	−10.00	80	.000

Pre tests: F1 = fluency, FL1 = flexibility, EL1 = elaboration, O1 = originality.
Post tests: F2 = fluency, FL2 = flexibility, EL2 = elaboration, O2 = originality.

Hypotheses 2 is supported. Although, we can see in Table 6 the existence of a weak positive link between time spent on Facebook and total fluency of students $r(77) = 0.23$, $p = .045$, the link between the total creativity of students and FBTime, is not statistically significant, thus, Hypotheses 5 is not supported.

To compare the four "Facebook use" groups (FB) on the multiple dimensions of creativity before the intervention we conducted a Multivariate Analysis of Variance (MANOVA) with the four FB groups as independent variables and the four dimensions of creativity fluency, flexibility, elaboration and originality as dependent variables. The MANOVA assumption that dependent variables are correlated was tested by examining bivariate Pearson correlation coefficients and as can be seen in Table 7 a statistically significant correlation was found. Also, Levene's test of variance homogeneity for all the dimensions of creativity and Box's M ($p = .432 > 0.05$) test were both met.

The statistical analysis, presented in Table 9, revealed that there were statistically significant differences between the four FB groups on the four dimensions of creativity: Pillai's Trace = 0.33, $F(12, 228) = 2.38$, $p = .007$, partial $\eta^2 = 0.11$ and power to detect the effect 0.96 and Wilks' $\lambda = 0.70$, $F(12, 196) = 2.38$, $p = .007$, partial $\eta^2 = 0.11$ and observed power .93. Follow-up ANOVAs showed that fluency $F(3,77) = 4.09$, $p = .009$, $\eta_p^2 = .14$, and flexibility $F(3,77) = 3.82$, $p < .013$, $\eta_p^2 = .13$, were the creativity components that contributed to the significant multivariate effects. Finally, a series of post-hoc analysis using Tukey's HSD tests showed that group FB2 ($M = 41.78$) scored in fluency significantly lower than all other groups FB1 ($M = 52.73$, $p = .059$), FB 3 ($M = 50.90$, $p = .060$), FB4 ($M = 52.04$, $p = .014$) this can be seen in Fig. 2. Also the flexibility scores of group FB2 ($M = 33.61$) were significantly lower than the flexibility scores of group FB1 ($M = 46.28$, $p = .011$). Group FB1 had the highest scores in all four components of creativity compared to other groups and it was followed by group FB4 with the second best scores in fluency, originality and flexibility.

The relationship between the FB groups and academic achievement, depicted in Table 10 and Fig. 3, suggests a negative link between academic achievement and extensive use of Facebook. However, an ANOVA test with dependent variable students' academic scores, showed no significant difference between the four FB (Facebook) Groups.

To examine how the four Facebook (FB) groups responded to the creativity enhancement intervention we conducted a repeated measures Multivariate Analysis of Variance (MANOVA) with time as within-subjects factor with two levels (level 1 = pre-test, level 2 = post-test), the dimensions of creativity (fluency, flexibility, elaboration and originality) as dependent variables and the four FB groups as independent variables. Tables 7 and 8 show that the MANOVA assumption of meaningful correlation between dependent variables was supported. Levene's test of variance homogeneity and Box's M test were both met. Results showed that there were not statistically significant differences in the enhancement of creativity between the four groups: Pillai's Trace = 0.20, $F(12, 228) = 1.35$, $p = .190$, partial $\eta^2 = 0.07$, power to detect the effect 0.74 and Wilks' $\lambda = 0.81$, $F(12, 196) = .34$, $p = .20$, partial $\eta^2 = .07$ and observed power .66. Therefore, Hypotheses 6 is not supported.

Table 6
Correlations.

	Points	TCreativity	F	FL	EL	O	FBTime
Points		.496**	.453**	.477**	.346**	.258*	-.165
TCreativity			.907**	.928**	.638**	.639**	.089
Fluency				.906**	.401**	.403**	.226*
Flexibility					.451**	.436**	.102
Elaboration						.291**	-.069
Originality							-.059
FBTime							

Note: $N = 79$ $^{*}p < .05$ $^{**}p < .01$ (2-tailed).
F = fluency, FL = flexibility, EL = elaboration, O = originality, Points = exam points-academic achievement, TCreativity = total creativity, FBTime = time spent daily on Facebook (in min).

Table 7
Pre-tests creativity dimensions correlations.

	F1	FL1	EL1	O1
F1		.853**	.328**	.339**
FL1			.397**	.379**
EL1				.224*
O1				

Note: $N = 81$ * $p < .05$ **$p < .01$ (2-tailed).
Pre tests: F1 = fluency, FL1 = flexibility, EL1 = elaboration, O1 = originality.
Post tests: F2 = fluency, FL2 = flexibility, EL2 = elaboration, O2 = originality.

Table 8
Post-tests creativity dimensions correlations.

	F2	FL2	EL2	O2
F2		.890**	.368**	.366**
FL2			.397**	.342**
EL2				.219*
O2				

Note: $N = 81$ * $p < .05$ **$p < .01$ (2-tailed).
Pre tests: F1 = fluency, FL1 = flexibility, EL1 = elaboration, O1 = originality.
Post tests: F2 = fluency, FL2 = flexibility, EL2 = elaboration, O2 = originality.

Table 9
Descriptive statistics and MANOVA, and follow-up ANOVAs results for creativity dimensions and Facebook groups (FB).

Creativity Dimension	FB	*N*	*Mean*	*SD*	*Value*	*F*	*df*	*Error df*	*p*	η_p^2
Fluency	1	11	52.73	9.93		4.09	3		.009*	.137
	2	23	41.78	11.92						
	3	20	50.90	10.46						
	4	27	52.04	12.86						
Flexibility	1	11	46.27	10.17		3.82	3		.013*	.129
	2	23	33.61	11.28						
	3	20	39.30	11.16						
	4	27	41.25	10.33						
Elaboration	1	11	3.45	1.29		.51	3		.674	.020
	2	23	3.30	1.33						
	3	20	3.25	1.29						
	4	27	2.96	1.22						
Originality	1	11	7.73	6.84		1.22	3		.307	.046
	2	23	4.78	4.88						
	3	20	4.00	5.28						
	4	27	5.74	5.50						
Pillai's Trace					.334	2.38	12	228	.007*	.111
Wilks' λ					.698	2.38	12	196	.007*	.113

Note: $N = 81$ * $p < .05$ **$p < .01$ (2-tailed).

4.4. Creativity and ICT knowledge and use

To examine the relationship between creativity and ICT knowledge and use, a univariate analysis of variance with dependent variable the total creativity of students and fixed factor the CKN- Computer Knowledge groups was conducted. Levene's test was met ($p = .443 > 0.05$). Results indicated a statistically significant difference between the four groups $F(3,77) = 2.82$, $p = .045$, $\eta_p^2 = .10$, observed power .67, and post-hoc analysis using Tukey's HSD tests showed that the total creativity of the 'expert' group was significantly higher compared to the total creativity of the 'basic' group (expert > basic, $p = .029$) and also higher than the 'average' group (expert > average, $p = .063$), providing partial support for Hypotheses 3. Differences between the other groups although existent and can be seen in Fig. 4, were not statistically significant.

A repeated measures Multivariate Analysis of Variance (MANOVA) with time as within-subjects factor with two levels (level 1 = pre-test, level 2 = post-test), the dimensions of creativity (fluency, flexibility, elaboration and originality) as dependent variables and the four CKN (Computer KNowledge) groups as independent variables was performed. Levene's test of variance homogeneity and Box's M test were both met. Results showed that there were not statistically significant differences in the enhancement of creativity between the four groups: Pillai's Trace = 0.19, $F(12, 228) = 1.28$, $p = .233$,. partial $\eta^2 = 0.06$, power to detect the effect 0.72 and

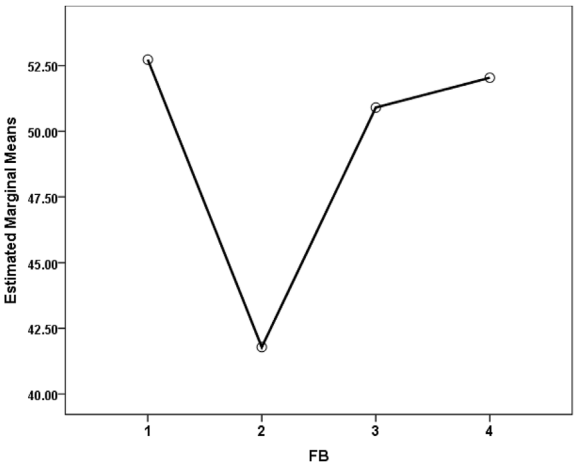

Fig. 2. Creativity (fluency) and facebook (FB) Groups.

Table 10
Descriptive Statistics Facebook Groups (FB) and Academic Achievement (Points).

FB	Points (mean)	SD	N
1	7.60	1.58	10
2	6.50	1.60	22
3	6.60	1.67	20
4	6.30	1.35	27
			N = 79

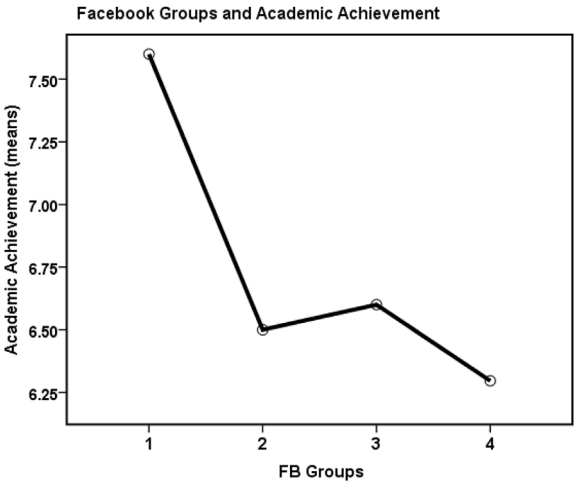

Fig. 3. Facebook Groups and Academic achievement.

Wilks' $\lambda = 0.82$, $F(12, 196) = 1.27$, $p = .241$, partial $\eta^2 = 0.06$, observed power .64. Therefore, Hypotheses 4 is not supported.

5. Discussion

Nowadays, creativity is a highly valued ability and its enhancement has become an educational objective. With the present study we designed and implemented an educational intervention aiming to develop the creativity of students in an academic environment with the integration of ICTs. After the implementation we conducted statistical analysis of the data and the results showed that this intervention had a very positive impact on students' creativity.

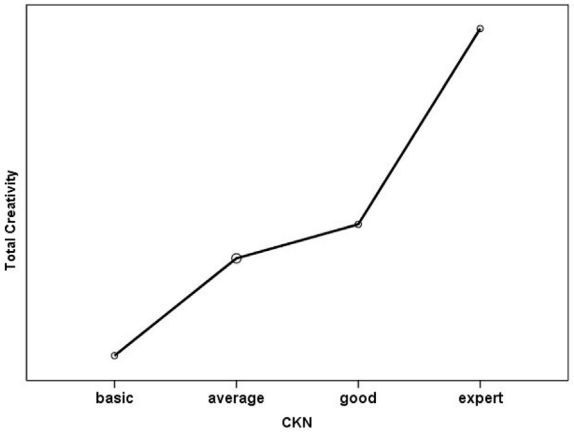

Fig. 4. Total Creativity (means) and CKN (computer knowledge) groups.

5.1. Creativity enhancement

Our main finding is that the educational intervention significantly enhanced all four dimensions of students' creativity, as measured by creativity tests. Participants' creativity was improved in quantity (fluency, flexibility) and quality (elaboration, originality) (Dixon, 1979; McVearry, VanMeter, Gaillard, & Meador, 2009; Runco & Acar, 2012). This finding is consistent with numerous studies and previous research suggesting that creativity can be stimulated and developed at any age if we use the right methods and techniques (Scott et al., 2004; Stine-Morrow et al., 2014; Tsai, 2013). Also, examination of each creativity dimension separately indicates that our intervention, like many previous creativity training programs, had a different effect on each creativity component. The most significant increase was found in fluency scores followed by originality scores and these results are congruent with past research and several meta-analyses which indicate that originality and fluency are the creativity components most affected by creativity training (Rose & Lin, 1984; Scott et al., 2004). An increase in fluency, which is defined as the number of produced ideas, indicates a stimulation of divergent thinking and sometimes is the only dimension of creativity assessed when we view creativity in terms of productivity (Runco & Acar, 2012). Originality which is the statistical infrequency or the novelty of the produced ideas is strongly correlated with fluency – when the number of ideas produced rises it is more probable to find an original idea (Kim, 2006) and this explains to a point the equally significant increase. Results also show a statistically significant increase in flexibility and elaboration. However, of interest is the fact that elaboration was the dimension of creativity that changed the least. This finding might be explained by previous studies proposing that elaboration is a higher-level cognitive ability, associated with both convergent and divergent thinking skills that require more time, knowledge and practice to be developed (Csikszentmihalyi, 1996; Ma, 2006).

5.2. Creativity and academic achievement

The results of this study are in total agreement with several previous studies suggesting a strong positive correlation between creativity, intelligence and academic achievement (Ai, 1999; Hansenne & Legrand, 2012; Naderi, Abdullah, Aizan, Sharir, & Kumar, 2010; Powers & Kaufman, 2004). This finding is also consistent with the multifaceted nature of creativity including both divergent thinking, measured with the divergent thinking creativity tests, and convergent thinking, measured with the final exams at the end of the semester. The final examination tests consisted of multiple choice questions that required a single 'correct' answer and obviously referred more to the convergent thinking of students (A. Cropley, 2006; Kim & Pierce, 2013a). Thus, the positive correlations between creativity and academic achievement, shown in Table 6, are totally explainable since they are actually correlations between the scores of the two different types of tests which measure the two aspects of the overall creative thinking: divergent and convergent (Cropley, 2006; DeHaan, 2013).

5.3. Creativity and facebook

An interesting finding of the present study is the relationship between students' creativity and Facebook. The results of Bivariate Pearson Correlation analysis presented in Table 6 showed a very weak positive link between students' total fluency and time spent on Facebook whereas correlations to the other creativity dimensions were negative but not statistically significant. In an attempt to investigate in more depth the existent relationships students were divided into four groups based on their Facebook usage habits. When we compared the four groups on levels of creativity the results revealed that Group FB1 which included students that almost did not use Facebook and most of them created a Facebook profile just to participate in the intervention, showed the highest level of creativity. However, contrary to what might be expected, and as can be seen in Table 9 and Fig. 2 the most creative group FB1 with the lowest Facebook usage, was followed closely by group FB4 including students who spent several hours on Facebook everyday. Group FB4 was followed by group FB3 consisted of students with a moderate Facebook usage and finally less creativity exhibited the

members of group FB2 who used Facebook almost daily and for very short time. These confounding results could be explained taking into account the multiple essence of creativity. Therefore, despite the fact that the two groups FB1 and FB4 included students with totally different patterns of Facebook usage, however, it is possible that their members shared some similar personality traits or other characteristics (intelligence, socioeconomic status, lifestyle, experience etc.) resulting in equal creative potential.

In our study we did not find any statistically significant relationship between Facebook use and the creativity enhancement process, contrary to our expectations and previous research (Alias et al., 2013; Rashid & Rahman, 2014). All students responded positively and their creativity was enhanced regardless of their Facebook usage habits. It is obvious that due to the relatively short time of implementation of our intervention the use of Facebook did not affect differently the creativity levels of students in the four groups.

5.4. ICT, facebook and academic achievement

In regard to academic achievement our results indicate the existence of a negative relationship between extensive use of Facebook and students' academic achievement, however, correlations did not reach statistical significance, in agreement with previous studies suggesting that there is no significant effect of Facebook usage on academic achievement (Huang, 2018; Kabre & Brown, 2011; Pasek et al., 2009; Wise et al., 2011). The above results are also in line with previous research literature suggesting that students use Facebook mainly for social purposes like communication, networking and personal satisfaction and not for active learning or academic work (Arteaga Sánchez et al., 2014; Madge, Meek, Wellens, & Hooley, 2009; Wise et al., 2011). As for the non significant negative link between Facebook and academic achievement could be attributed to the distraction effect of Facebook usage which has diverse but usually negative impact on individuals' performance (Rouis et al., 2011; Sana, Weston, & Cepeda, 2013).

In the present study statistical analysis showed that students with higher knowledge and use of ICTs scored higher on creativity and this finding is line with studies claiming that creativity needs expertise including knowledge and technical proficiency (Amabile, 1997). Another interpretation would be given if we consider the theoretical model of personal innovativeness (Agarwal & Prasad, 1998; Mahat, Ayub, Luan, & Wong, 2012; Nov & Ye, 2008). Thus, it is conceivable that very creative students would be also very receptive and knowledgeable about new technologies.

Concerning creativity enhancement, we did not find any significant effect of ICT knowledge and according to our results all groups benefitted from the intervention regardless of their level of ICT knowledge and expertise. One possible explanation might be that for the limited time of this intervention, it is difficult differences in knowledge and expertise in a particular domain, to be translated as significant differences in creativity enhancement level, especially when we measure the overall creativity of individuals.

5.5. Limitations and suggestions for future research

Like any human construct this study has several limitations.

One limitation regards the representativeness of the sample. Since participation to the intervention was voluntary, it is possible that from the very beginning, we recruited the most creative students who were curious, interested, and willing to explore the unknown.

Another limitation is related to measurement of time spent on Facebook and Facebook usage habits of students which were estimated based on participants' self-report, therefore, precision of results is limited by human subjectivity. Unfortunately, we have to acknowledge, like other researchers before us (Junco, 2013), that as long as we measure Facebook time and usage based on self-report measures and not with monitoring software installed in all ICT devices that students can use (computers, tablets, smart TVs, smart watches, mobile phones etc.) there will always exist the factor of wrong self-evaluation and bias.

A further limitation is that we did not use any tests to measure convergent thinking, possibly some IQ-tests, RAT, or other tests to examine if the intervention stimulated convergent thinking. We did not include this aspect in our study, because we were afraid that many tests including IQ-tests would affect negatively the game-like atmosphere. Certainly, we encourage other researchers to explore possible improvements of the game and techniques that would measure convergent thinking.

6. Conclusions, implications and significance of the present study

In the present study, we developed a creativity enhancement method with the integration of ICT aiming to make it appealing to students, inexpensive and easy to implement, yet effective, motivational and with the most possible positive results. After its development we tested it and evaluated the results. We also examined in more depth correlations between creativity, creativity enhancement, academic achievement, ICTs and Facebook usage. To summarize, our findings:

1. Results indicate that our educational creativity enhancement intervention with the inclusion of ICTs was successful, as expected. Creativity of students was enhanced in all four dimensions of fluency, flexibility, elaboration and originality encouraging the wider use of ICT in education.
2. Creativity of students measured with divergent thinking creativity tests correlated positively with their academic achievement assessed by end of semester exams, providing more support to the theory of a strong connection between creativity and knowledge.
3. Students that did not use Facebook at all showed the highest creativity followed closely by those that used Facebook for several hours daily, indicating that Facebook usage was unrelated to total creativity of students.

4. Students with basic knowledge and use of ICTs exhibited less total creativity measured with Divergent Thinking Tests, suggesting the need for social mobilization for more extensive integration of ICT in education.
5. Differences between students concerning Facebook usage did not have a significant effect on stimulation of creativity.
6. All students benefitted from the creativity enhancement intervention regardless of their ICT knowledge differences, reaffirming the necessity for an innovation advancing education with the integration of ICT that would help societies to obtain a competitive edge and face emerging challenges.

In regard to practical implications, our study provides useful results and is of significance for several reasons:

1. In the creativity literature, many researchers and teachers have developed and suggested various methods of creativity enhancement and most of them successful. Some researchers even proposed separate courses focused on creativity and have designed and used their own tools and techniques for implementation. However, several of the suggested interventions are complicated and it is hard to replicate the techniques or the particular tools used. Also, to introduce new courses into the curricula of educational institutions is difficult and demanding. The intervention that we propose is simple, inexpensive, relatively easy to implement and according to our results effective. It uses means and tools that are already present in students' lives, and it can be easily replicated and incorporated into an existing course, without any additional investments or major changes in the curriculum something really important with today's economic constraints.
2. Our findings support the notion that the integration of ICT with a stress-free game-like web-based approach to learning is motivational and effective in enhancing students' creativity. Also our results revealed that students with higher knowledge and acceptance of ICTs exhibited higher levels of creativity. Hence, teachers, educators and education planners that want to stimulate students' creativity should consider exploiting the opportunities provided by ICTs and use them to bring change to the curriculum and the learning process.
3. As suggested by existing literature, questions generated by students promote active learning (Furtak et al., 2012; Luxton-Reilly & Denny, 2010). With our study we provide additional evidence that questions constructed by students and specifically open essay questions promote creativity. Therefore, students would benefit if their teachers make a more extensive use of open questions and study cases in their teaching and in the testing procedure.
4. Our game-like, challenging, web-based and team-structured intervention was successfully tested in an academic setting, but it might be easily reproduced and adjusted for use in an organizational setting. In line with numerous previous studies our results show that play stimulates creativity at every age. We believe that our method can be modified and applied as a motivational game of creativity training in the industry and especially in the creative industries. We propose an easy and inexpensive way to stimulate the creativity of research and development teams, and work teams in various business sectors.
5. Instructors that want to facilitate creativity should take into account that the complex phenomenon of creativity needs time, persistence and systematic approach including the widespread use of ICT and social networks.

Before closing, we must note that this intervention enhances only one aspect of creativity as measured by divergent thinking tests. Considering the complexity of creativity as a phenomenon, we acknowledge that this intervention, although beneficial, does not ensure creative achievement. However, we believe it helps the collective human effort to discover, encourage and develop creativity and hopefully this study would be useful to researchers, teachers, instructors and anyone else that works towards this goal.

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