Divergent Movement Ability and Digital learning environments:

Opponents or collaborators

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Abstract

Creativity and the Information and Communication Technologies are considered as key factors for social and personal development. New technologies are valuable tools on learner's creativity cultivation. When the children act as movers they modify, adapt and combine fundamental movements. When creativity is expressed with a movement, is defined as a creative movement and its outcome as a creative product. The aim of the present study was to investigate if the proposed educational technique has been effective and furthermore to investigate the effects of a Digital Learning Environment (DLE) focused on basketball elements on the motor creativity of elementary school students. 86 students divided in 2 groups participated in the study. According the results, the DLE and its content effect with no significant difference among the three subgroups of the experimental group and help the students to express themselves, to improve their previous divergent movement ability.

Keywords: Digital Learning Environment; motor creativity; fluency; flexibility

1. Introduction

The Information and Communication Technologies (ICT) and creativity are considered as key factors for social and personal development (Florida, 2002; Florida & Tinagli, 2004; Kampylis, Berki, & Saariluoma, 2009). Creativity is generally viewed as essential to children's learning and treated as an 'across the curriculum' ideal, just like ICT (Christophersen, 2006). The increasing development of the ICT affects

every aspect of social, economic and cultural activities, of modern people's life worldwide (Giddens, Duneier, & Appelbaum, 2007) including Greece (Koustourakis & Panagiotakopoulos, 2008). As earlier considered, one of the basic requirements for education in the future is to prepare learners for the participation in a networked, information society (Jefferies, 2003; Lehtinen, Hakkarainen, Lipponen, Rahikainen, & Muukkonen, 1999). Our information society is a society of learning (Anastasiadis, 2000).

New technologies are valuable tools on learner's creativity cultivation. Tacchi (2004), asserts "…as notions of creativity are spread more widely, the nature of production and consumption is seen to be changing from mass to networked models. Network architectures and the network economy are seen by many to offer opportunities for innovation and creativity along with exponential growth, and new technologies are seen to offer unprecedented freedom and levels of access" (2004, p. 91).

Actually, previous research has discussed that ICT should be used to raise creativity into the educational framework (Dale, 2008; Ogunleye, 2002).

New technologies need to be integrated as the main part of the educational process and through them teachers could cultivate students' creativity (Cooper, 2000).

Indeed, Sutherland et al. (2004) argues that the creative production of new and innovative teaching and learning practices, need the new technologies to take active action on the educational process.

ICT can support specific creative thinking skills such as investigating ideas, making links, giving rise to ideas, making alterations to points of view, using   imagination (Christophersen, 2006).

Though Grainger et al. (2004) still contend that "teachers need to be convinced that creativity is a critical component in a world dominated by technological innovations".

There are distinctive types of ICT that can support creativity described as: provisionality, interactivity, capacity, range, speed, accuracy, quality, automation, multimodality, neutrality, social credibility and automatic functions (Fisher & Williams, 2012; Loveless, 2002).

The ICT support the preparation of a preliminary version of text, collaborative filtering, restructure, rearrange, refining, processing, and methodical analysis and evaluation of ideas, theories, and contents.

The multimedia software allow students to manufacture different perspective drawings on a topic and modeling software's support the alternative presentation of diverse collections of data (Christophersen, 2006).

Due to the flexible connectivity of mobile tools, they create new innovative paths for significant meaningful interactions among known and unknown persons or groups (Andronico et al., 2003; Caudill, 2007; Kadirire, 2007; Motiwalla, 2007; Naismith, Lonsdale, Vavoula, & Sharples, 2004)..

Today's students are familiar with the multi or parallel processing. Hyperlinking has played a crucial role on the development of those specific skills and Prensky contrasts this with the digital immigrants who prefer linear or singular processing (Prensky, 2001a, 2001b).

It is recognized that European economies must focus on the development of intelligent economies and in order to do so, the European Council suggests that they concentrate on inspiration and innovation procedures and practices (Europa, 2009; European Commission, 2008; Florida & Tinagli, 2004; Sawyer, 2006a).

According to the Observatory for the Greek Information Society, a percentage of 93% of the children

aged 10 -15 use personal computers and 73% have an internet access (OGIS, 2008).

Children use home computers and other mobile electronic devices which are either connected or not to the internet and the World Wide Web. That in general is been viewed as positive if it's compared with the habit of watching television. However, both of them raise concerns about the possible effects on children's physical and psychological well-being (Andersen et al., 2003; Tatemichi et al., 2004).

It must be admitted that, many studies underline the effects that computer games expose children to (including physical risks, trigger epileptic seizures in certain users, seizures, hand injuries, changes in heart rate (Fylan, Harding, Edson, & Webb, 1999). The access on a home computer by children, increases the overall time amount that children spend facing a screen such as a television, computer, e.t.c. (Hesketh, Wake, Graham, & Waters, 2007) at the expense of other activities, especially physical activities (Antoniou, Patsi, Mpempetsos, & Yfantidou, 2006) putting them at obesity risk (Vandelanotte, Sugiyama, Gardiner, & Owen, 2009; Wake, Hesketh, & Waters, 2003).

From another point of view, cognitive researchers have proposed that computer games could be a significant building block to computer literacy, because it boosts children's ability to read and visualize 3d images and track numerous images simultaneously (Subrahmanyam, Kraut, Greenfield, & Gross, 2001).

Creativity has been a subject which has concerned societies since the ancient years. Plato and Aristoteles keep a special place for creativity in their text.

During the timeline of our days creativity has been investigated under different philosophical frames. From the beginning of the 20th century to the last decades of the same century, scientists from different fields have contributed to the public dialogue nature versus nurture of creativity.

During the last two decades, researchers support that creativity and even more the creative actions could be seen as an amalgam of complex interactions between biological, psychological and social factors.

Creativity plays a significant role in the education of the 21st century. Basic skills, especially those that are linked to creativity must be cultivated in all educational systems and at all the education levels (EC, 2008/C 86/01). At school, such skills are associated to creativity and are referred to curiosity, intuition, critical and lateral thinking, problem solving, experimentation, risk taking and the ability to learn from failure, use of the imagination and hypothetical reasoning (EC, 2008/C 141/10).

Of course the first step in order to understand creativity is to define it. According to Kaufman & Sternberg (2007) most definitions of creative ideas include three components: a) creative ideas must introduce something different, new, or innovative, b) are of high quality, and c) must be appropriate to the task or some redefinition of that task. That's why a creative response is novel, good and relevant.

The 'traditional' and the 'new' (Odena, 2001) or the artistic and the scientific (Feist, 1999) concepts of creativity are in coexistence. The traditional concept of creativity is credited to people who contributed significantly to a field and the validity of their contribution is recognized by the community. On the other hand, the 'new' concept is linked to a psychological notion of 'imaginative thinking' and has wide uses in the school frame (NACCCE, 1999; Savage & Fautley, 2007).

Efforts to discriminate between extraordinary and ordinary forms of creativity include the Boden's distinction between psychological (P) and historical (H) creativity (Boden, 1996), distinction between

'little C and - big C types of creativity (Craft, 2001, 2002; Gardner, 1993), and Czikszentmihalyi's (1988) separation of personally creative and unqualifiedly creative individuals. Craft argues that a major contradistinction has been made between 'high' creativity - shown by the exceptional person - and 'ordinary' or 'democratic' creativity, which can be shown by everyone (NACCCE, 1999).

Having a definition that situates creativity in a particular context helps to bridge a connection between creativity as a study of eminence (Big C) and a study of everyday creative acts (little c creativity), thereby broadening the study of creativity Beghetto and Kaufman (2009) argue that all students have multi-creative potential and assert that "the possibility of expressing multi-creative potential varies across levels of creativity (most likely at smaller-c levels of creativity; least likely at professional and eminent levels of creativity)" (p.39), thus, Beghetto and Kaufman presented the "Four-C Model" of creativity which increases the "Big-C/little-c" creativities' separation in order to include two extra types of creativity: "mini-c" creativity (Beghetto & Kaufman, 2007) and "Pro-c" creativity (Kaufman & Beghetto, 2009). Into that model, mini-c creativity include the Runco's "personal" aspects of creativity (Runco, 2004) as well as Cohen's "developmental" aspects (Cohen, 1989). The "Pro-c" is ascribed to those professional creators who have not yet attained a notable ranking (Beghetto & Kaufman, 2009).

At school level, the terms of creativity with the most widespread use are everyday, democratic or little c creativity (NACCCE, 1999; Craft, 2000; Craft, Jeffrey & Leibling, 2001; Jeffrey & Woods 2003; sawyer, 2006; Starko, 2005; Wilson, 2005). The main characteristic of everyday, small or democratic creativity is its comprehensive character. It can be cultivated in all people and promoted in all subjects. Taking into account the universal character of creativity, it is argued that it is possible in all fields / tasks of human cognitive development (NACCCE, 1999). Creativity as a thinking process includes at least three thinking forms: the convergent and divergent thinking ability, as well as the critical thinking ability (Hudgins & Edelman, 1988).

Thus, in the first decade of the 21st century researchers tried to link various school subjects with the cultivation of creativity, such as science (Frost, 1997; Farrow, 1999), literacy (Goodwin, 2004; Martin, Lovat & Purnell, 2007), mathematics (Brown &Liebling, 2005; Haylock & Thangata, 2007), informatics (Packard & Higgins 2010), music, arts (Kiehn, 2003; Campbell & Scott-Kassner, 2006) and physical education (Bournelli, 1998; Lavin, 2008).

The term that has had a commanding influence on the research literature of the relationship between creativity and movement is that of "motor creativity". When the children act as movers they modify, adapt and combine fundamental movements. Their movement is a combination of relationships with the space, time, other persons and/or objects. When creativity is expressed with a movement, it is defined as a creative movement and its outcome as a creative production (Wyrick, 1968). Wyrick's research focused on motor creativity, which she defined as a combination of concepts for a new locomotor model with emphasis on the kinesthetic perception. That new locomotor prototype may be either the solution in a given question, the expression of an idea or emotion by means of the human body.

Duricek & Duricekov, (1986) defined motor creativity as the ability of the child to express a personal idea, or reconstruct and perfection an already known locomotor movement in a form that is new to the child.

According to Storr (1991) creative production is "…the result of the free and spontaneous expression of the child".

In 1992, McBride defined critical thinking relative to the psychomotor domain as "… reflective thinking that is used to make reasonable and defensible decisions about movement task or challenges" (p. 119).

He proposed a four phase schema that involves: a) cognitive organizing, b) a cognitive action, c) cognitive outcomes and d) psychomotor outcomes.

The movement is a key factor not only for the cultivation and progress of motor creativity but also for critical thinking as well. (Bournelli, 1998, 2002; Chen & Cone, 2003; Cleland, 1994; Cleland & Gallahue, 1993; Cleland, Helion, & Fry, 1999; Derri & Pachta, 2007; Gallahue, 2002; McBride, Gabbard, & Miller, 1990; Mosston & Ashworth, 1997; Zachopoulou & Makri, 2005).

To this opinion, Cleland (1994) adds: "When children solve fundamental or divergent movement tasks in as many different ways possible, they must not only generate alternative ideas but also act on those ideas using specific criteria to modify and change each movement pattern" (p. 230).

Creative thinking demands the cognitive sides of fluency, flexibility and originality. In addition, motor creativity demands the motor characteristics of motor fluency (as many movement responses as possible), motor flexibility (different responses than any previous responses – changes in effort, changes in spatial aspect, etc) and motor originality.

Specific research tools are used to assess motor creativity. These tools evaluate the components of motor creativity that were previously mentioned. The Thinking Creatively in Action and Movement (TCAM) (Torrance, 1981) which is designed for children aged 3-8 years is considered internationally one of the most popular. Other researchers used other similar tests in order to evaluate the motor creativity of the children.

Bournelli (1998), Wang, (2003) and Zachopoulou et all (2006) use other tests in order to evaluate the effects of educational programs that was focused on the cultivation of creativity.

Stepping forward Cleland and Gallahue (1993) and Cleland (1994) evaluated an aspect of the motor creativity, the divergent movement ability as an outcome of the divergent thinking using two of the three criterion of motor creativity: motor fluency and motor flexibility. According to their suggestions the production of alternative and different solutions to a given problem are an outcome resulting from a combination of critical thinking elements. Researchers argued that when a child is asked to produce different and alternative motor responses to a given motor problem, then the children's divergent movement ability (phase c – cognitive outcomes and phase d – psychomotor outcomes) requires focus on the given problem and the use of prior relative knowledge –and information (phase b – cognitive action). So, divergent and critical thinking are involved for the expression of creativity or divergent movement ability.

By the end of the 20th century Cleland & Pearse, (1995) and McBride & Cleland (1998) suggested a theoretical educational approach by physical education teachers for nurturing critical thinking in physical education elements such as sports, games and motor skills

The most popular educational techniques involve divergent thinking and problem-solving in order to develop creativity (Plucker & Runco, 1999). Regarding creativity in physical education, the productive

teaching styles from the Mosston's Spectrum (Mosston & Ashworth, 1997) are used (Digelidis & Papaioannou, 2004; Digelidis, Theodorakis, Zetou, & Dimas, 2007; Theodorakis, Digelidis, Zetou, & Dimas, 2008).

Although the use of computer technology in classrooms remains yet an innovative approach of teaching, teachers with creativity might not use technology as intensively as they use other creative strategies in the classroom (ChanLin, Hong, Horng, Chang, & Chu, 2006). In previous work the author was focusing on a Digital Learning Environment (Panagiotis Antoniou, Apostolakis, Anastasiadis, & Karipidis, 2009), the Future learning Environment (Fle3). Fle3 is server software for computer supported collaborative learning (CSCL). (Leinonen & Kligyte, 2003; Leinonen, Kligyte, & Seitamaa-Hakkarainen, 2003; Leinonen, Kligyte, Toikkanen, Pietarila, & Dean, 2006).   The present study was used in order to support physical education lessons and more specifically, for teaching basketball skills under the "Six Thinking Hats" technique (de Bono, 2006).

The aim of the present study was to investigate if the proposed educational technique has been effective and furthermore to investigate the effects of a Digital Learning Environment, focused on basketball elements, on the divergent movement ability of elementary school students.

2. Method

2.1 Subjects

In the current study 86 students participated (43 boys and 43 girls). All of whom were students of the last grade of elementary schools (boys, m= 11.52, sd = 0.27 years and girls, m=11.54, sd= 0.31 years). They were divided in 2 groups: the control group (11 boys and 9 girls) and the experimental group (33 boys and 33 girls) which was divided into three different subgroups (1st subgroup: 11 boys and 10 girls. 2nd subgroup: 9 boys and 12 girls, 3rd subgroup: 14 boys and 10 girls).

According to Vamvoukas (1991), when classrooms or samples of classes are conducted in a pedagogical experimental design, it is almost impossible to modify the classroom or the sample of the class in order to achieve the perfect sample for the experiment. In practice, the researcher is looking for groups –classes with similar characteristics so that it could be considered that the sample groups belong to the same population (p 362 – 363). According to this, each one of the subgroups and the control group were different classes of elementary schools.

2.2 Experimental procedure

Two weeks before the start of the study (one hour per week) the treatment group was familiarized with Fle3. The children were taught the basic operations of Fle3 by the investigator.

For the duration of the study (i.e 10 weeks) all the 86 subjects participated in the school's regular physical education program. The schools provided two 45 minutes physical education classes per week, and these classes were taught by physical education teachers. Basketball was taught once a week and it was the first physical education lesson of the classes. The basketball lessons of the 6th grade of the Elementary school include 10 fundamentals. The eight (8) of those fundamentals mentioned as player's

individual technique (Basic Basketball Individual Skills -BBIS) and the following two (2) of them referred to the Partial Basketball Game Tactics (PBGT).

The most essential skills and tactics that were needed, in order to play the basketball game, have been introduced to the students by the physical education teacher. The instructions from the teachers' book were followed in order to build the lesson plans (Digelidis, Theodorakis, Zetou, & Dimas, 2007b).

Treatment (i.e. experimental groups) individuals contacted the computer laboratory - after the school program - once per week for an hour, individually. The DLE (Fle3) had been applied on the laboratory server. The Fle3 could be easily password accessed from an interactive menu. This menu provides the user with a visual feedback so that it's obvious in which part of the module the user was or what action the user was working on. The contexts of the lessons were based on activities in order to give students competence in selecting and executing creative solutions to the individual skill or modified game problems. Every week the context of the lesson followed the ordinary weekly basketball lesson plan. In other words, the knowledge that had to be learned and the movement problems that required solutions followed the ordinary weekly basketball lesson plan. On the student's desktop there was a link with a student's book (Digelidis, Theodorakis, Zetou, & Dimas, 2007a) and the link of two websites correlated to basketball game developed by the investigator. The websites were uploaded on laboratory server. Every situation (BBIS or PBGT) was supported with digital video sequences, animations, text photographs, etc. The users have the opportunity to think creatively on the given relative basketball problem and to reply following the deBono's Six Thinking Hats technique (de Bono, 2006). The processes followed the relevant basketball situation hats sequence as described on the "de Bono Thinking 24x7" software manual (The McQuaig Group Inc, 2005). The students could interact between the colleagues concerning their answers by watching the other students' desktop or using collaborative tools of the Fle3. Subjects had the freedom to leave the computer and try every movement pattern they thought about.

2.3 Measures

The Divergent Movement Ability Test (DMA) (Cleland & Gallahue, 1993) was applied in order to assess the students' divergent movement.

The Divergent Movement Ability Test (DMA) involves three fundamental movement tasks:

The first task is used to examine critical thinking in the specified locomotor play area in order to achieve a variety of locomotor movement patterns as well as changes in direction (four cones was placed diagonally 1.5 m apart one from the other, a mat 4ft × 6ft, a jumping rope tied, 18 inches high, in two pillars and finally a hoopla hoop was horizontally sited up on three foam cubes).

As for the second task the subject's capability to make shapes on, below, beside or at the end of an 18″ high bench was assessed. The task was emphasized on shape and levels (high, medium or low) and designed to determine how many body parts were used in order to execute stability movements by the subjects.

The third task evaluated the subject's ability to handle a 9″ ball within a U-shaped space (10 ft × 15 ft) that was bounded by one wall and cones.

Motor fluency was calculated by summing the different responses and recorded on score sheets. Motor flexibility was the number of thematic changes. The score sheets were designed so that the observer could record each subject's movement response by checking the appropriate category. If a subject performed a variation of a fundamental movement pattern not included on the score sheet, that variation was written on the subject's score sheet. The number of different responses was totaled for the 1 and ½ minute trials. Each different fundamental movement pattern and the variation of these represented a "different" response. The total number of different responses on all three divergent movement tasks (a total of 9 minutes) represented the subject's score and was defined as the subject's score. Each subject's performance was independently scored by two trained observers.

The questionnaire of "Personal computers use" (Vitoulis, 2005) was used in order to assess the subject's level of computer use. The questionnaire was divided in two sections: the section for the demographics data of the participants and the section for the items (20 multiple choice questions).

The questionnaire of "Personal computers use" was individually completed before the pretest of the DMA by each one of the participants. All the participants completed the questionnaire and then the level of their computer use was calculated in a five points Likert's scale (1= very low to 5 very high) (Vitoulis, 2005).

Pretests of the DMA were administrated prior to treatment, the posttests were given after the completion of the treatment and the follow up tests were executed a month after the completion of the treatment. All trials took place in the multipurpose room of the schools. The presentation order of the three tasks was counterbalanced. Standard verbal instructions were provided and described what each child should do on the three fundamental tasks in order to familiarize them with the testing environment. Each movement task was individually presented and the investigator demonstrated a simple, possible movement response on each task. The investigator and the observer were present during all testing. Two trials, each lasting 1.5 min were provided for each task. Total movement time for all three tasks was 9 minutes. Rest periods of 1 min in length were provided between each of the trials, and rest periods of two minutes were given between each of the three DMA tasks. Subjects were reminded during the rest period that they were to continue to 'find as many ways as possible'.

The score sheets of the DMA, were designed so that the observer could record each subject's movement response by checking the appropriate category. If a subject performed a variation of a fundamental movement pattern not included on the score sheet, that variation was written on the subject's score sheet. The number of different responses was totaled for the 1 and ½ minute trials. Each different fundamental movement pattern and the variation of these represented a "different" response. The total number of different responses on all three divergent movement tasks (a total of 9 minutes) represented the subject's score. Each subject's performance was independently scored by physical education teachers who were trained as observers.

3. Results

The two factors of motor creativity, motor fluency and motor flexibility were established for the three subgroups.

Two mixed two between within subjects analysis were contacted once to assess the impact of subgroup (1= 1st subgroup, 2= 2nd subgroup and 3= 3rd subgroup) and the level of computer use (LofCU) (1= very low to 5= very high) on participants scores on the motor fluency across a three time period (pretest, posttest and 1-mth follow up), Mauchly's W = 0.991, x2(2) = 0.442, p =.802. There was no significant interaction between subgroup, LofCU and time, F (16,102) = .668, p=.809 there was no significant interaction between LofCU and time, F (8,102) = 1.191, p =.312 and, there was no significant interaction between time and subgroup, F (4,102) = 1.142, p =.341. There was a significant main effect for time, F (2,102) = 54.71, p<.0005. There was no significant main effect of LofCU, F (4, 51) = .466, p =.76, there was no significant main effect of subgroup, F (2,51) = 2.007, p = .145, and there was no significant interaction between LofCU and subgroup, F (8,51)= 1.011, p=.44.

Secondly in order to assess the impact of subgroup and LofCU on participants scores on the motor flexibility across three time period, Mauchly's W = 0.987, x2(2) = .668, p = .716. There was no significant interaction between subgroup, LofCU and time, F (16, 102) = .447, p = .965, there was no significant interaction between LofCU and time, F (8. 102) = 1.335, p =.225, and there was no significant interaction between time and subgroup, F (4. 102) = 1.246, p = .296. There was a significant main effect for time, F (2,102) = 27.808, p <.0005. There was no significant main effect of LofCU, F (4,51) = 2.206, p =.081, there was no significant main effect of subgroup, F(2,51) = 1.424, p = .25, and there was no significant interaction between LofCU and subgroup, F (8,51)= .949, p =.486.

The two factors of motor creativity, motor fluency and motor flexibility were estimated for the two groups. Two mixed two between within subjects analysis were conducted once to assess the impact of group (experimental group, control group) and LofCU on participants scores on the motor fluency across three time period (pretest, posttest and 1-mth follow up), Mauchly's W = 0.98, x2(2) = 1.601, p =.449 and secondly to assess the impact of group (experimental group, control group) and level of computer use (1= very low to 5= very high) on participants scores on the motor flexibility across three time period (pretest, posttest and 1-mth follow up), Mauchly's W = 0.967, x2(2) = 1.592, p =.451. An alpha level of .05 for all statistical analysis was contacted.

As far as the first analysis, there was no significant interaction between group, LofCU and time, F (8,152) = 0.25, p = .98 and there was no significant interaction between LofCU and time, F (8,152) = 1.24, p = .28. There was significant interaction between time and group, F (2,152) = 6.76, p<.002, and there was a significant main effect for time, F (2,152) = 24.8, p<.0005. There was no significant main effect of LofCU, F (4, 76) = .64, p=.63 and of the interaction between LofCU and group, F (4, 76) =.15, p=.96 but there was a significant main effect of group, F (1, 76) = 18.78, p<.0005. Using the LSD criterion for significant between the levels of time indicated that there were significant differences between pretest (m = 36.54, sd= 1.11) and posttest (m = 42.59, sd = .77) and follow up (m = 41.14, sd=.86) but there was no significant differences between the posttest and follow up.

According to the results of motor flexibility analysis, there was no significant interaction between group, LofCU and time, F (8,152) =0.65, p=.73, there was no significant interaction between LofCU and time, F (8,152) = .64, p = .74 and there was no significant interaction between time and group, F (2,152) = 1.52, p = .022.There was a significant main effect for time, F (2,152) = 15.91, p<.0005. Using the LSD

criterion for significant between the levels of time indicated that, there were significant differences between pretest (m = 60.45, sd= 1.23) and posttest (m = 64.71, sd=1.13) and follow up (m = 67.87, sd= 1.19) also there were significant differences between the posttest and follow up with the follow up scoring higher than posttest.

Additionally, there was no significant main effect of LofCU, F (4, 76) = .25, p = .91 and of the interaction between LofCU and group, F (4, 76) = 1.57, p = .19, but there was a significant main effect of group, F (1,76) = 9.89, p<.002, with control group scoring lower (m = 61.47, sd= 1.65) than the experimental group (m= 67.21, sd= .79).

4. Discussion

Data and information facilitate the creation of knowledge. People use computer programs to process information to gain insight and knowledge. Computing facilitates exploration and the discovery of connections in information. Computational manipulation of information requires consideration of representation, storage, security and transmission. Computing affects communication, interaction and cognition (Anastasiadis, 2000).

According to the results of the study among the three subgroups, there was no significant difference concerning the divergent movement ability. According to the divergent movement ability, significant differences were mentioned among the two groups by the results. On the other hand there were no significant differences between the starting levels of computer use.

It seems that the method positively influences the motor fluency of the children if it suggested that all the other factors which possibly effect the development remain sustained.

Previous computer knowledge was not a barrier to the creative expression and as Gaskins (2016) supports too, the use of computers fosters the creation of artifacts and creative expression.

Previous participation in locomotor skills and games has found that either increases or drops creative production (Zachopoulou & Makri, 2005). Low scores of standard deviation, for both motor fluency and motor creativity, which were met in the present study, are supporting the opinion that previous movement experience and the level of cognitive development probably contribute to higher scores on motor flexibility and motor fluency (Cleland, 1994; Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005). At the present study previous experience in basketball game was not investigated for none of the groups' members. Further studies should examine the relationship between creativity and domain previous experience. Interviews with children could provide data for children's feeling during creative process of thinking, doing or/and acting.

When divergent thinking mechanism was activated by a DLE under the Six Thinking Hats technique, creativity flourished. When opportunities for creative thinking and acting are present on a supportive environment then children will continue to widen their movement repertoire. They will apply their ability to modify, adapt, or/and combine fundamental movement patterns creating new ones, for them, using successfully their divergent movement ability and further more they are going to continue these ways of thinking and acting lifelong (Bournelli & Mountakis, 2008). Concluding, it is believed that DLE under the Six Thinking Hats technique helped the students to express themselves, to improve their previous

divergent movement ability.

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